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(54) Remote supervisory and controlling system performing dimming control of light loads.

(57) A dimming switch terminal unit for monitoring a dimming-up switch and dimming-down switch and a dimming control terminal unit for performing dimming control of an associated light load are connected to a central control unit through a two-wire signal line. The central control unit accesses each of the terminal units to perform time-divisional multiplex transmission of monitor data and control data therebetween. When the dimming-up switch or dimming-down switch is depressed, the central control unit detects monitor data indicating the switch depression and sends to the dimming control terminal unit control data instructing it to start dimming-up or dimming-down control. The dimming control terminal unit continues to dim up or dim down the associated light load until the dimming-up switch or dimming-down switch is released and the dimming control terminal unit receives control data instructing it to stop dimming up or dimming down the light load.

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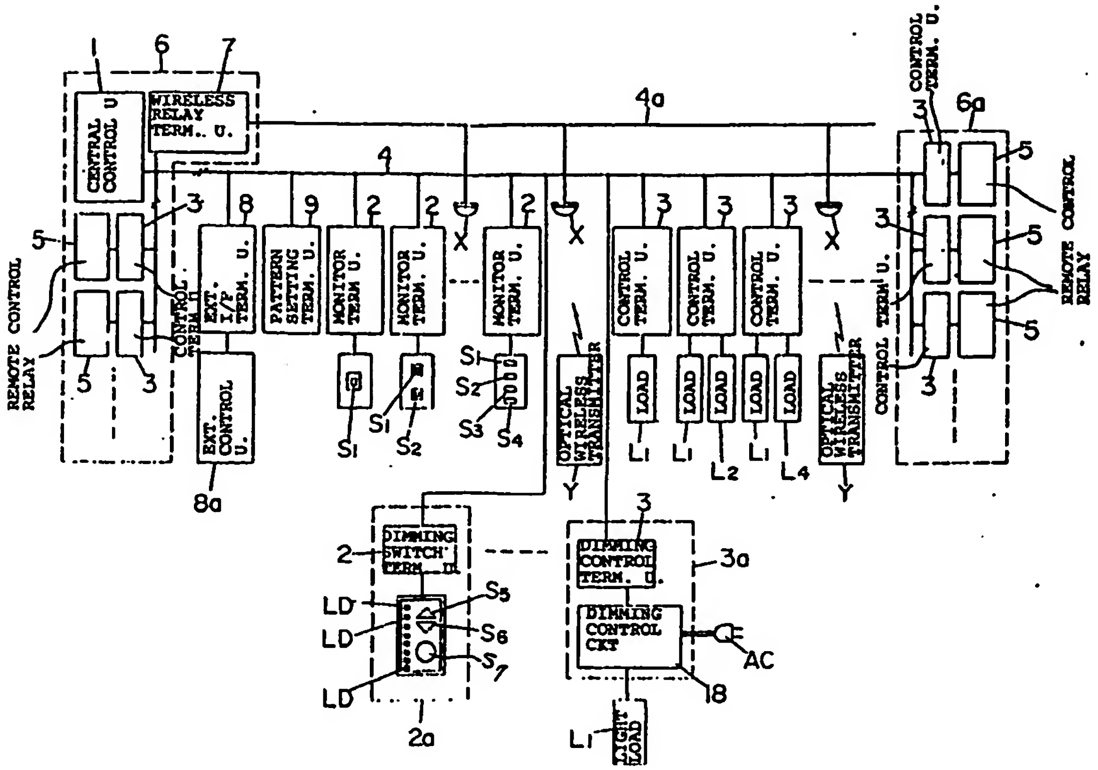
FIG. 1


CENTRAL CONTROL U
WIRELESS RELAY TERM. U.
REMOTE CONTROL RELAY
CONTROL TERM U
EXT. I/P TERM. U.
PATTERN SETTING TERM. U.
MONITOR TERM U.
EXT. CONTROL U.
OPTICAL WIRELESS TRANSMITTER
CONTROL TERM. U.
LOAD
DIMMING SWITCH TERM. U.
DIMMING CONTROL TERM. U.
DIMMING CONTROL CKT
LIGHT LOAD
AC

REMOTE SUPERVISORY AND CONTROLLING SYSTEM PERFORMING DIMMING CONTROL OF LIGHT LOADS

BACKGROUND OF THE INVENTION

The present invention relates to a remote supervisory and controlling system in which a central control unit accesses terminal units for time-divisional multiplex transmission of data to control loads, in particular to perform dimming control of light loads, connected to the terminal units.

Such a system is basically described, except for the variable dimming control, in U.S. Patent No. 4,780,872 and Japanese Patent Application Unexamined Publication Nos. Hei. 1-114194 and Hei. 1-140894.

Japanese Patent Application Unexamined Publication No. Sho. 64-86480 discloses a remote supervisory and controlling system in which a central control unit accesses terminal units to perform time-divisional multiplex data transmission therebetween and which performs dimming control of light loads. In this system, the central control unit (main operation panel) accesses a dimming control terminal unit to send dimming control data, and the dimming control terminal unit control, based on the received dimming control data, its high frequency output to dim an associated light load. However, this system has a disadvantage that the dimming control of the light load can only be conducted by the central control unit, and therefore cannot provide sufficient operational easiness of the system.

Another system may be conceivable in which a central control system manages the dimming control level for each dimming control terminal unit. That is, when manipulation of a dimming-up switch or dimming-down switch is detected, the dimming control level stored in a RAM is increased or decreased one level by one level, and the altered level is each time transmitted to the dimming control terminal unit. However, such a system has a problem of low transmission efficiency of a transmission signal, because it is required to continue to send the dimming level while the dimming-up switch or dimming-down switch is depressed.

Further, there is known a dimming control system employing time-divisional multiplex data transmission in which a central control unit (operation panel) located at a center facility controls a plurality of dimming control terminal units at once. However, such a system cannot simultaneously control the dimming control terminal units distant from the central control unit. Further, it is difficult in such a system to alter the group setting of the dimming control terminal units, i.e., light loads.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of the above problem of the prior art and, therefore, an object of the invention is to provide a remote supervisory and controlling system which can perform dimming control of light loads from an arbitrary place.

Another object of the invention is to provide a remote supervisory and controlling system which can perform dimming control of light loads with high transmission efficiency of a transmission signal sent from a central control unit to a dimming control terminal unit.

Further object of the invention is to provide a remote supervisory and controlling system employing time-divisional multiplex data transmission which can simultaneously control grouped dimming control terminal units, i.e., light loads, distant from a central control unit, and also can alter the group setting of the dimming control terminal units.

According to the present invention, a remote supervisory and controlling system, in which a plurality of terminal units are connected to a central control unit through a two-wire signal line, and the central control unit accesses each of the terminal units to perform time-divisional multiplex transmission of monitor data and control data between the central control unit and each of the terminal units, comprises:

a dimming switch terminal unit, connected to the signal line, for monitoring at least a dimming-up switch and a dimming-down switch;

a dimming control terminal unit, connected to the signal line, for performing dimming-up and dimming-down control of an associated light load; and

the central control unit, for, upon depression of the dimming-up switch or dimming-down switch, detecting dimming monitor data sent from the dimming switch terminal unit which indicates depression of the dimming-up switch or dimming down switch and sending to the dimming control terminal unit first control data which instructs it to start the dimming-up or dimming down control, and for, upon release of the dimming-up switch or dimming-down switch, sending to the dimming control terminal unit second control data which instructs it to stop the dimming-up or dimming-down control;

wherein the dimming control terminal unit continues by itself the dimming-up or dimming-down control during a period from reception of the first control data to reception of the second control data.

The system may be constructed such that

each time a predetermined variation has occurred in a dimming level of the light load, the dimming control terminal unit sends to the central control unit level monitor data indicating the dimming level of the associated light load, the central control unit sends third control data indicating the dimming level to the dimming switch terminal unit, and the dimming switch terminal unit indicates the dimming level on the basis of the third control data.

The system may further comprises:

a group dimming terminal unit, connected to the signal line, for monitoring at least a group dimming-up switch and a group dimming-down switch; and

memory means, provided in the central control unit, for storing addresses of selected ones of the dimming control terminal units;

wherein when the group dimming-up switch or group dimming-down switch of the group dimming terminal unit is manipulated, the central control unit controls the selected ones of the dimming control terminal units on the basis of the addresses stored in the memory means and group monitor data sent from the group dimming terminal unit which indicates manipulation of the group dimming-up switch or group dimming-down switch so that a plurality of the light loads connected to the respective selected ones of the dimming control terminal units are subjected to dimming control at once.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a remote supervisory and controlling system according to an embodiment of the present invention;

Fig. 1A is a block diagram showing a central control unit used in the system of Fig. 1;

Fig. 2 includes waveform diagrams showing a transmission signal and an interruption request signal;

Fig. 3 is a block diagram showing a dimming control terminal unit used in the system of Fig. 1;

Fig. 4(a) is a block diagram showing a dimming switch terminal unit used in the system of Fig. 1;

Fig. 4(b) is a chart showing an example of setting of terminal unit functions;

Fig. 5 includes diagrams showing a monitor data signal;

Fig. 6 is a block diagram showing another example of a dimming switch terminal unit used in the system of Fig. 1;

Fig. 7 is a flow chart showing the operation of the system of Fig. 1;

Fig. 8 is a partial diagram showing a remote supervisory and controlling system according to a second embodiment of the invention which includes a group dimming terminal unit;

Fig. 9 is a chart showing an example of group setting of dimming switch terminal units;

Fig. 10 is a flow chart showing the group dimming control operation performed by the system of Fig. 8;

Fig. 11 is a circuit diagram showing an embodiment of a dimming switch terminal unit;

Fig. 12 is a chart showing a format of data to be written into an EEPROM in the circuit of Fig. 11;

Fig. 13 is a perspective view showing a disassembled state of the dimming switch terminal unit of Fig. 11;

Fig. 14 is a perspective rear view showing a manipulation block;

Figs. 15 and 16 are sectional views showing an assembly of parts of the dimming switch terminal unit of Fig. 13;

Fig. 17 is a plan view of a cover used in the dimming switch terminal unit of Fig. 13;

Fig. 18 is a front view showing the dimming switch terminal unit of Fig. 13 installed on a cosmetic plate;

Fig. 19 is a circuit diagram showing an example of a dimming control terminal unit;

Fig. 20 is a perspective view showing a disassembled state of the dimming control terminal unit of Fig. 19;

Fig. 21 is a perspective view showing an appearance of the dimming control terminal unit of Fig. 20; and

Fig. 22 is a sectional view showing the dimming control terminal unit of Fig. 20.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be described with reference to the accompanying drawings. In the drawings, the same reference numerals represent the parts having the same functions, and therefore redundant descriptions for those may be omitted.

Fig. 1 shows the general construction of a remote supervisory and controlling system according to an embodiment of the present invention. In the drawing, connected to each other by a two-wire signal line 4 are a central control unit 1, a plurality of monitor terminal units 2 having respective addresses for monitoring switches S_1-S_4, a plurality of control terminal units 3 for controlling loads L_1-L_4, an optical wireless relay terminal unit 7, an external interface terminal unit 8 and a pattern setting terminal unit 9. An external control unit 8a such as a host computer is connected to the external interface terminal unit 8.

A schematic block diagram of the central control unit 1, which serves as a transmission unit for the remote supervisory and controlling system, is shown in Fig. 1A. The central control unit 1 includes a driver circuit 22a and a receiver circuit

22b directly coupled to the multiplex transmission signal line 4. A power source 23 for the driver circuit 22a is provides the necessary energization for the driver circuit 22a. The driver circuit 22a and receiver circuit 22b are connected to terminals of a central processing unit (CPU) 21. A random access memory (RAM) 25, a read-only memory (ROM) 26, and an electrically erasable programmable ROM (EEPROM) 27 are connected to the CPU 21 through a bus line. The RAM 25 temporarily stores data at the time of data transmission between the CPU 21 and ROM 26. The ROM 26 stores a program for converting an output signal of the CPU to a multiplex transmission signal, and also stores addresses. The EEPROM 27 stores on/off states of the terminal units, and also stores group patterns of the control terminal units. The CPU 21 is driven by a power source 28 which provides the necessary energization for the CPU 21. Reference numeral 28a denotes a voltage-regulating circuit. The central control unit 1 manages all of the addresses, patterns, etc., for the load control operations.

A transmission signal V_S transmitted from the central control unit 1 is a bipolar (±24 V), time-divisional multiplex signal, and consists of, as shown in Fig. 2(a), a start pulse signal ST indicative of the start of the signal transmission, a mode data signal MD indicative of a signal mode, an address data signal AD representing 8-bit address data for accessing one of the terminal units 2 and 3, a control data signal CD representing control data for controlling the loads L_1-L_4, a check sum data signal CS, and a return wait period signal WT for setting a signal return period. The data transmission is performed using a pulse-width modulation technique.

Each of the terminal units 2, 3, 7, 8 and 9 is equipped with a terminal power circuit for rectifying and smoothing the transmission signal V_S sent through the signal line 4. That is, these terminal units are supplied with electric power by the central terminal unit 1 through the signal line 4. Each of the terminal units 2, 3, 7, 8 and 9 takes in the control data included in the received transmission signal V_S when the address data included in the transmission signal V_S coincides with its own address data. Further, each of those terminal units returns, in synchronism with the return wait period signal WT, a monitor data signal (status monitor information of a switch, operation status information of a load, etc.) as a current mode signal which is sent by connecting the two wires of the signal line 4 by a resistor of appropriate low impedance. In order to easily check the signal contention at the time of the group access (simultaneous access of a plurality of terminal units), such a return signal V_B is designed to be a signal of 4 bits V_{B1}-V_{B4} each consisting of, as shown in Fig. 5, a pair of wide and narrow pulses respectively indicating "1" and "0". The return signal V_B is returned in synchronism with prescribed periods T_1-T_4 (R_0-R_7) in a return period T_B.

The data transmission from the monitor terminal unit 2 and optical wireless relay terminal unit 7 to the central control unit 1 is performed by using an interruption technique. In the interruption process, a dummy transmission signal V_S, in which the mode data signal MD is set to a dummy mode, is always transmitted from the central control unit 1. When an interruption request signal V_i as shown in Fig. 2(b), which is returned from one of the terminal units 2 and 7, is received in synchronism with the start pulse signal ST, the central control unit 1 detects a terminal 2 or 7 requesting an interruption by sending a transmission signal V_S of an interruption polling mode, and accesses the detected interruption-requesting terminal 2 or 7 to make it return data. (The detailed operation will be described later.)

Based on the monitor data (e.g., status information of switches S_1-S_4) thus returned from one of the terminal units 2, 7, ..., the central control unit 1 generates the control data to be transmitted to the corresponding control terminal unit 3 for controlling the associated load L_1-L_4, and accesses the control terminal 3 and sends, by time-divisional multiplex transmission, the generated control data to the terminal unit 3 to control the load L_1-L_4. Further, based on the monitor data (e.g., operation status information of the loads L_1-L_4) returned during the return period, the central control unit 1 sends, by time-divisional multiplex transmission, the control data to cause operation indicators (lamps) of the terminal unit 2, 7, ... to flash.

In Fig. 1, dimensions of the terminal units 2, 3, ... installed in a distribution switch board 6 or a relay control board 6a are normalized according to Japanese Industrial Standard (C-8370, Supplement 5). Remote control relays 5 for load control, i.e., latching relays which can also be turned on or off by at-hand switches, are controlled by respective outputs of the control terminal units 3.

As shown in Fig. 3, a dimming control terminal unit 3a consists of a power source section 10 for producing a power for the terminal unit 3a by rectifying and smoothing the transmission signal V_S sent through the signal line 4; a signal processing section 11 for performing signal processing on the transmission signal V_S and the return signal V_B, etc.; an address setting section 12 for setting an own address; a relay drive section 14 for driving a relay 15 based on the control data; a monitor input section 16 for monitoring the operation status of the relay 15; a zero-cross detection section 17 for outputting a zero-cross signal in synchronism with

zero-cross points of a commercial power line AC; and a dimming control circuit 18 for dimming a light load L_1 by phase control based on dimming control data and the zero-cross signal, and for on/off-controlling the light load L_1 based on the status of a contact r.

As shown in Fig. 4(a), a dimming switch terminal unit 2a consists of a power source section 10; a signal processing section 11; an address setting section 12; a function setting section 13a for setting terminal unit functions (described later); a drive section 14; an operation indication section 15' for indicating the dimming level and on/off status of the corresponding light load L_1 by an array of light-emitting diodes LD; and a monitor input section 16 for monitoring the status of a dimming-up switch S_5, and a dimming-down switch S_6. Fig. 4(b) shows an example of setting of the terminal unit functions. In this example, using 4-bit data, functions can be set such as an input method, i.e., a selection between a switch input terminal unit (SW) and a contact input terminal unit (CT), delayed turning off, temporary turning off, combined action of contacts, and an operation time.

As described above, in the embodiment of the remote supervisory and controlling system, the control data and monitor data are transmitted through the two-wire signal line 4 by time-divisional multiplex transmission. Connected to the signal line 4 are the dimming switch terminal unit 2a for monitoring the dimming-up switch S_5 and dimming-down switch S_6, and the dimming control terminal unit 3a which is equipped with the dimming control circuit 18 for dimming the light load L_1. The central control unit 1 includes a signal processing means for monitoring, by interruption process, the manipulation status of the switches S_5 and S_6 in the dimming switch terminal unit 2a, and for generating the dimming control data. The central control unit 1 accesses the corresponding dimming control terminal unit 3a and transmits the dimming control data, to perform the dimming control of the associated light load L_1. Therefore, the dimming control of the light load L_1 can be conducted from an arbitrary place by connecting the dimming switch terminal unit 2a to the signal line 4.

Using an optical wireless transmitter Y and receiver X, data of switch manipulation corresponding to the manipulation of the dimming-up switch S_5 and dimming-down switch S_6 may be returned to the central control unit 1 through the optical wireless relay terminal unit 7 and the signal line 4. In this case, the dimming control of the light load L_1 can be performed easily from an arbitrary place, improving operational easiness of the system.

Fig. 6 shows a dimming switch terminal unit 2a' in which a load number setting section 13 is employed, instead of the function setting section 13a, which sets numbers of loads selected from the loads L_1-L_4 connected to respective load control circuits (4 circuits in the embodiment) in the corresponding control terminal unit 3a. The other construction and operation of the terminal unit 2a' are the same as those of the dimming switch terminal unit 2a.

The operation of the system of Fig. 1 will be described below. Fig. 7 shows an example of a data transmission method which transmits switch monitor information to the central control unit 1 by interruption process, when a variation in a switch input is detected in the dimming switch terminal unit 2a due to the manipulation of the switch S_5 or S_6. When the dimming-up switch S_5 in the dimming switch terminal unit 2a is manipulated (depressed) and a switch input variation is detected, the input variation is set in an input latch and an interruption request pulse V_i is immediately sent out in synchronism with the start pulse signal ST of the dummy mode transmission signal V_S which is always transmitted. Upon reception of the interruption request signal V_i, the central control unit 1 sends the polling mode transmission signal V_S to search the interruption-requesting terminal unit 2a and makes it return its own address. In the embodiment, upper 4 bits of the 8-bit address data are sent by the transmission signal V_S of the interruption polling mode to perform group-access to all the terminal units on a 16 units basis. If the interruption-requesting terminal unit 2a is found in the group-accessed 16 terminal units 2a, ..., the central control unit 1 makes the detected interruption-requesting terminal unit 2a return the lower 4 bits of its own 8-bit address data, and combines the upper 4 bits which the central control unit 1 has sent and the returned lower 4 bits to complete the address of the interruption-requesting terminal unit 2a, i.e., to determine the interruption-requesting terminal unit 2a.

Next, based on the address thus identified the central control unit 1 accesses the interruption-requesting terminal unit 2a, sends the transmission signal V_S of an input latch monitor mode to make it return the input latch data as monitor data during the prescribed return period, and thereby recognizes the variation status of the dimming-up switch S_5. Then, the central control unit 1 sends the transmission signal V_S of an input latch resetting mode to reset the input latch in the dimming switch terminal unit 2a whose dimming-up switch S_5 has been manipulated, and makes the terminal unit 2a remain in its waiting state until the next switch input variation occurs.

Next, judging, based on the recognized input latch data, that the dimming-up switch S_5 has been manipulated, the central control unit 1 accesses the dimming control terminal unit 3a corresponding to

the interruption-requesting terminal unit 2a, and sends the transmission signal V_S of a status monitor mode to make the terminal unit 3a return the operation status (dimming status) of the light load L_1 as the monitor data. Receiving the status monitor data (on/off status and dimming level status of the light load L_1) from the dimming control terminal unit 3a, the central control unit 1 recognizes the statuses of the dimming control terminal unit 3a. Then, the central control unit 1 sends a dimming-up control signal to the dimming control terminal unit 3a. In response thereto, in the dimming control terminal unit 3a, the dimming control circuit 18 establishes a mode for increasing the dimming level, so that the dimming control terminal unit 3a continues to increase the brightness of the light load L_1 by itself. Since the dimming control circuit 18 performs its control operation so that the dimming control terminal unit 3a itself can change the brightness level (in this case, dimming-up) of the light load L_1, the central control unit 1 can perform its processes on other terminal units while the brightness level is being changed.

If the continued dimming-up operation in the dimming control terminal unit 3a causes a brightness variation larger than a preset value, this fact is transmitted from the dimming control terminal unit 3a to the central control unit 1 by an interruption process, and the central control unit 1 generates data representing a level variation. The central control unit 1 transmits the generated data through the signal line 4 to the dimming switch terminal unit 2a, which then indicates the on/off status and the dimming level status of the light load L_1 by the light-emitting diodes LD. This process is performed on all such occasions.

In the meantime, when depression of the dimming-up switch S_5 is released, the dimming switch terminal unit 2a detects this fact, and sends a stop signal to the central control unit 1 in the same interrupting operation as described above, generating the interruption request signal V_I. The central control unit 1 transmits a stop signal to the dimming control terminal unit 3a. Upon reception of the stop signal, the dimming control terminal unit 3a stops the dimming-up operation by the dimming control circuit 18. Then, the central control unit 1 sends the transmission signal V_S of an input latch resetting mode to reset the input latch in the dimming switch terminal unit 2a, and makes the dimming switch terminal unit 2a remain in its waiting state until the next switch input variation occurs. In this manner, the dimming-up operation of the light load L_1 using the interruption technique is completed.

The dimming-down operation can be performed in the same manner as the dimming-up operation described above.

As described above, the remote supervisory and controlling system shown in Fig. 1 has an advantage that the central control unit 1 can perform its operations other than the dimming control operation while the dimming control terminal unit 3a itself dims the associated light load L_1. Further, since the dimming switch terminal unit 2a indicates the dimming level of the corresponding light load L_1, a user, recognizing the indicated dimming level, can release the dimming-up switch S_5 or dimming-down switch S_6 to thereby easily set the dimming level at a desired level.

Fig. 8 is a partial diagram showing the construction of a remote supervisory and controlling system according to a second embodiment of the invention. The second embodiment is different from the first embodiment of Fig. 1 in that a group dimming terminal unit 2b is connected to the signal line 4. In the following, group dimming control according to the second embodiment will be described, in which a plurality of light loads L_1 are dimmed up or dimmed down at a time. The group dimming terminal unit 2b has a construction similar to the dimming switch terminal unit 2a shown in Fig. 4(a). There are provided on the front face a dimming-up switch S_8, a dimming-down switch S_9, a switch S_{10} for turning on or off the light loads L_1, and an array of light-emitting diodes LD for indicating the on/off status and dimming level status of the light loads L_1.

In the memory section 27 of the central control unit 1, which receives a signal from the group dimming terminal unit 2b, a control area (i.e., light loads L_1 to be controlled) of each group dimming terminal unit 2b is preliminarily stored by group setting, etc. When one of the switches S_8-S_{10} of one group dimming terminal unit 2b is depressed, the central control unit 1 controls a plurality of grouped switch terminal units 2a of the group so as to perform at once the dimming control or on/off control of the light loads L_1 belonging to the group.

Fig. 9 shows an example of grouping 16 dimming switch terminal units 2a. The dimming switch terminal units 2a marked with o are included in the corresponding group.

Fig. 10 is a flow chart of an example of the group dimming control, in which three dimming switch terminal units $2a_1$-$2a_3$ are controlled to perform the dimming control by the corresponding dimming control terminal units $3a_1$-$3a_3$. That is, the dimming switch terminal units $2a_1$-$2a_3$ are set and stored as one group in the memory section 27 of the central control unit 1 to perform the grouped dimming control.

First, when the dimming-up switch S_8 of the group dimming terminal unit 2b is depressed, the central control unit 1 sends "dimming-up commands" to the respective dimming control terminal

units $3a_1$-$3a_3$ set in the memory section 27. In response thereto, each of the dimming control terminal units $3a_1$-$3a_3$ gradually increases brightness of the associated light load L_1 by itself (with the signal processing section 11 and the dimming control circuit 18). As already described above, the central control unit 1 can perform other processes during this period. After a predetermined brightness increase of the associated light load L_1 by its own control, each of the dimming control terminal units $3a_1$-$3a_3$ generates the interruption request signal V_i to inform the central control unit 1 of the brightness increase, and the central control unit 1 recognizes the brightness at this instant and sends "dimming level indication commands" to the dimming switch terminal unit $2a_1$-$2a_3$. Each of the dimming switch terminal units $2a_1$-$2a_3$ indicates by means of the light-emitting diodes LD the brightness level of the corresponding light load L_1. The central control unit 1 can perform other processes until the release of the dimming-up switch S_8 - (described below).

Upon release of the dimming-up switch S_8 of the group dimming terminal unit 2b, the central control unit 1 detects a signal therefrom and sends "dimming stop commands" to the dimming control terminal units $3a_1$-$3a_3$ to stop the brightness increasing operation of the dimming control terminal units $3a_1$-$3a_3$.

The dimming-down control of the light loads L_1 can be performed in the same manner as the dimming-up control described above. Further, the on/off control of the light loads L_1 can be performed at once by the group dimming terminal unit 2b.

As described above, the remote supervisory and controlling system shown in Fig. 8 has advantages that grouped light loads L_1 can be dimmed up or dimmed down simultaneously, and the group setting can easily be altered.

In the following, an embodiment of the dimming switch terminal unit 2a for monitoring the switches S_5-S_7 will be described in detail.

In Fig. 11, the dimming switch terminal unit 2a is made up of a signal processing circuit 110 consisting of a microcomputer, an address setting section 111 consisting of an EEPROM, an optical signal receiver 112 including a photodiode PD and transistors Q_5 and Q_6, an optical signal transmitter 113 including a light-emitting diode LD and a transistor Q_4, a power source circuit 114 including a Zener diode ZD and a transistor Q_2, a returning circuit 115 including a resistor R and a transistor Q_3, a resetting circuit 116, and an oscillator circuit 117. As described above, the switches S_5, and S_6 are switches for dimming-up and dimming-down the brightness of the light load L_1, respectively. The switch S_7 is a switch for turning on or off the light load L_1.

While being rectified by a diode bridge DB, the transmission signal V_S received through the signal line 4 is input to a signal input terminal SIG of the signal processing circuit 110. The power source circuit 114 provides an electric power for the signal processing circuit 110 by regulating the rectified voltage of the transmission signal V_S. The signal processing circuit 110 judges whether the address data in the received transmission signal V_S coincides with the own address set in the address setting section 111. When the address coincidence occurs, the signal processing circuit 110 takes in the control data transmitted from the central control unit 1, and controls light-emitting diodes LDa and LDb for indication of load operation (on: red; off: green). Further, the signal processing circuit 110 checks the status of the switches S_5-S_7 to generate the monitor data, and makes the return circuit 115 send the return signal V_B including the monitor data as the current mode signal, which is sent by connecting the two wires of the signal line 4 with a low-impedance resistor R, to the central control unit 1 through the signal line 4.

The data writing into the address setting section 111 (EEPROM) is performed by the signal processing circuit 110. That is, the signal processing circuit 111 processes the signal received by the optical signal receiver 112 to produce data to be written into the address setting section 111, which is 32-bit data having the prescribed format as shown in Fig. 12. The signal to be received by the optical signal receiver 112 is an optical wireless signal transmitted from a data setting device (not shown). A response signal such as a reception confirmation signal is transmitted as another optical wireless signal from the optical signal transmitter 113 to ensure the reliable wireless transmission between the dimming switch terminal unit 2a and the data setting device.

Figs. 13-17 are views showing the specific structure of the dimming switch terminal unit 2a according to the embodiment. More specifically, Fig. 13 is a overall perspective view showing a disassembled state of the dimming terminal unit 2a. Fig. 14 is a perspective rear view of a manipulation block 122. Figs. 15 and 16 are sectional views showing an assembly of a printed circuit board 130, a cover 120b and the manipulation block 120. Fig. 17 is a plan view of the cover 20b.

In these figures, the three switches S_5-S_7 for load control and the corresponding six light-emitting diodes LD_1-LD_6 for dimming level indication and light-emitting diodes LDa and LDb for on/off indication are provided on the front side of the terminal unit case 120 so that the switches and the corresponding diodes are associated with each other. The terminal unit case 120 consists of a case

body 120a which is box-like and open to the fore side and the cover 120b having integral fixing pieces 121. The case body 120a and cover 120b are assembled together by fitting side protrusions 127b of the cover 120b into holes 127a of the case body 120a. Each of the fixing pieces 121 has a screw hole 121d for a cosmetic cover and two fixing holes 121b for direct installation to a wall. A fixing portion is formed by the fixing holes 121b, and fixing holes 121a for a wiring box and L-shaped fixing holes 121c for pinching metal fittings both provided in the cover 120b.

The manipulation block 122 to be in contact with the switches S_5-S_7 is provided on the front side of the cover 120b, and assembled with the cover 120b by inserting nails 128 into holes 128b of the cover 120b. Ends of three manipulation handles 123 are connected to a connecting piece 125 through thin elastic pieces 124 to form the integral manipulation block 122. A name cover 126 is fixed into a front dent of each manipulation handle 123 by pressed insertion. A label 147 is fitted into a groove 148 of each manipulation handle 123 so that the name cover 126 is located on the rear side of the name cover 126. On the rear surface of each manipulation handle 123, there are provided a protruded switch-depressing rib 123b and a return spring piece 123a which is integral with and protruded from the manipulation handle 123. An elastic force for returning the manipulation handle 123 is obtained by the elastic contact of the return spring piece 123a to the front surface of the cover 120b. A protrusion 129 is protruded from the other end of each manipulation handle 123, and is engaged with a hole 129a of the cover 120b to prevent the manipulation handle 123 from lifting off. The three manipulation handles 123 are integral parts of the manipulation block 122, as described above, and can be manipulated by a user with a "piano touch."

The light-emitting diodes LDa and LDb for on/off indication, the light-emitting diodes LD_1-LD_6 for dimming level indication, and the photodiode PD and light-emitting diode LD for reception/transmission of an optical wireless signal are mounted, i.e., aligned on the printed circuit board 130 which is housed in the terminal unit case 120. In the cover 120b of the terminal unit case 120, there are formed an opening 131 for protruding therefrom the light-emitting diodes LDa and LDb, photodiode PD and light-emitting diode LD, an opening 132 associated with the light-emitting diodes LD_1-LD_6 for dimming level indication, and holes 134 for protruding therefrom manipulation portions 133 of the switches S_5-S_7. Also the connecting piece 125 of the manipulation block 122 has openings 131a and 131b corresponding to the opening 131, and six openings 32a corresponding to the opening 132. A light guide 135 made of transmissive resin is fixed into a groove 136 of the connecting piece 125 (by a both-sides-adherent tape) to cover the openings 131a, 131b and 132a. In addition, a filter, such as an infrared-light-transmissive filter, for selectively transmitting only the optical wireless signal is fitted into the opening 131a.

The dimming switch terminal unit 2a having the above construction is assembled in the following manner. First, terminal plates 150 are inserted into the case body 120a, ribs 150a are folded, and terminal screws 150a are fixed into the terminal plates 150. Lead wires 130a of the printed circuit board 130 are connected to the terminal plates 150. After a nameplate 152 has been stuck to the cover 120b, the printed circuit board 130 is fitted into the cover 120b and then the cover 120b is fitted to the case body 120a. Next, the light guide 135 is stuck to the groove 136 of the manipulation block 122 by a both-sides-adherent tape. After labels 147 are placed in the grooves 148 of the manipulation handles 123, name covers 126 are fitted into the respective manipulation handles 123. The manipulation block 122 is fitted to the cover 120b by inserting the protrusions 129 and nails 128 of the manipulation block 122 into the holes 129a and 128a of the cover 120b, respectively. Finally, a nameplate 53 is stuck to the case body 120a.

Fig. 18 shows an example of installation of the above dimming switch terminal unit 2a, in which the terminal unit 2a is fixed to a wiring box buried in a wall, etc., more specifically to a cosmetic plate 144 of a usual wiring apparatus.

In the following, the operation of the dimming terminal unit 2a of the embodiment will be described.

The 32-bit data to be written into the address setting section 111, i.e., EEPROM consists of, as shown in Fig. 12, 4-bit page data, 4-bit upper address data, 4-bit lower address data, 4-bit load number data, 8-bit identification data, 4-bit return data A, and 4-bit return data B. Such 32-bit data can freely be written into or read from the address setting section 111 by the signal processing circuit 110 at any time required. That is, when it is required to alter the own address, the kind of terminal unit, the control method or monitor method at the time of system installation or layout modification of loads and switches, necessary data are set by the data setting device and transmitted as an optical wireless signal. The optical wireless signal is received by the optical signal receiver 112, processed by the signal processing circuit 110, and written into the address setting section 111, i.e., EEPROM. Since the EEPROM continues to store data even in the occurrence of an electric power failure, there is no need of incorporating a backup

power source. Further, since data can be rewritten electrically, the address alteration can easily be performed.

Next, the on/off control and the dimming control of the light loads L_1 will be described in detail. As shown in Fig. 11, the on/off switch S_7, dimming-up switch S_5 and dimming-down switch S_6 for the light loads L_1 are connected to input terminals $\overline{IN_3}$, $\overline{IN_1}$ and $\overline{IN_0}$, respectively.

(1) On/off control:

The terminal $\overline{IN_3}$ of the signal processing circuit 110 is of active-L type. Therefore, the input signal becomes low every time the switch S_7 is depressed, and the light load L_1 is turned on or off in accordance with depression of the switch S_7. The signal processing circuit 110 only detects the falling edge of the input signal.

(2) Dimming-up control:

The input terminal $\overline{IN_1}$ is of active-L type, and the input terminal IN_2 is of active-H type. Therefore, the input signal to the terminal $\overline{IN_1}$ becomes low in response to depression of the switch S_5, and the brightness of the light load L_1 continues to increase while the switch S_5 is depressed. In this case, the low level signal is also input through a diode D_1 to the terminal IN_2. Upon release of the switch S_5, the terminal $\overline{IN_1}$ is supplied with a high level signal by means of a pull-up resistance built in the signal processing circuit 110, and the dimming level is kept at a level of the time instant of the switch release.

(3) Dimming-down control:

The input terminal $\overline{IN_0}$ is of active-L type. Therefore, like the case of the dimming-up control, the brightness of the light load L_1 continues to decease while the switch S_6 is depressed. Upon release of the switch S_6, a high level signal is supplied to the terminal $\overline{IN_0}$ and the dimming level is kept at a level of the time instant of the switch release.

In response to a turning-on manipulation of the switch S_7, the light-emitting diodes LDa starts emitting red light. In response to a turning-off manipulation of the switch S_7, the light-emitting diode LDb starts emitting green light. In the case of the dimming-up and dimming-down control, the signal processing circuit 110 controls the light-emitting diodes LD_1-LD_6 according to the current dimming level of the light load L_1.

The dimming switch terminal unit 2a of the above embodiment has an advantage that the address data can easily be rewritten by using the optical wireless signal, making it possible to eliminate dipswitches. Further, by virtue of the integrated manipulated block having the three manipulation handles, it is not necessary to separately incorporate three manipulation handles, improving the easiness of manufacture.

In the following, an embodiment of the dimming control terminal unit 3a for dimming the light load L_1 will be described in detail.

Fig. 19 shows the circuit construction of the embodiment of the dimming control terminal unit 3a. A transmission processing circuit 210 consisting of a microcomputer is connected through a transceiver circuit 211 to the signal line 4 at a terminal t_1. The transceiver circuit 211 consists of a receiver section 211a having a transistor Q_1 and a transmitter section 211b having a transistor Q_2 and a resistor R_1. The transmission signal V_S sent from the central control unit 1 through the signal line 4 is provided to the transmission processing circuit 210 through the receiver section 211a. On the other hand, the current mode signal can be returned from the transmission processing circuit 210 to the central control unit 1 by turning on the transistor Q_2 and thereby connecting the two wires of the signal line 4 through the resistor R_1. Power supply to the transmission processing circuit 210 is performed by full-wave rectification of the signal from the signal line 4 by a diode bridge DB and voltage regulation by a power source circuit 212 including a transistor Q_3, a Zener diode ZD and a capacitor C_1. The diode bridge DB also serves as part of the transmitter section 211b. The receiving status of the transmission signal V_S is indicated by the flashing of a light-emitting element LD_2 connected to the transmission processing circuit 210.

Address data of the dimming control terminal unit 3a and function data for setting functions of the transmission processing circuit 210 are stored in a data memory section 213 consisting of an EEPROM. Data to be stored in the data memory section 213 is generated in the transmission processing circuit 110 by processing a signal received by an optical signal receiver circuit 214 including a photodetector PD_1 and transistors Q_4 and Q_5. The signal received by the optical signal receiver circuit 214 is a wireless signal, such as an infrared light signal, transmitted from the externally provided data setting device (not shown). When the wireless signal is received, an optical signal transmitter circuit 215 including a light-emitting element LD_1 and a transistor Q_6 returns to the data setting device a wireless response signal which is responsive to the contents of the received wireless signal and confirms the signal reception, setting completion, etc.

The transmission processing circuit 210 is connected to a dimming control circuit 216 consisting of a microcomputer, which phase-controls a power

control device T on the basis of data transmitted from the central control unit 1. A commercial power line AC is connected to a terminal t_2, and the light load L_1 is connected to a terminal t_3. Inserted between the terminals t_2 and t_3 are a contact r_1 of a latching relay R_{y1} and a phase control circuit 217 including the power control device T and a photocoupler PC_1. The latching relay R_{y1}, which is controlled by an output of the dimming control circuit 216 through a relay drive circuit 218 including transistors Q_7-Q_{10}, is equipped with two contacts r_1 and r_2. The contact r_2 is adapted to return its on/off status to the dimming control circuit 216. The light-emitting element of the photocoupler PC_1 in the phase control circuit 217 flashes on the basis of an output of the dimming control circuit 216 provided through a drive circuit 219, and the photodetecting element thereof phase-controls the power control device T so that the light load L_1 operates at a dimming level set in the dimming control circuit 216. In the above manner, the dimming control circuit 216 controls the light output of the light load L_1 under the condition that the contact r_1 of the latching relay R_{y1} is closed to actuate the light load L_1. The power-supplying status from the commercial power line AC is input to the dimming control circuit 216 from a power source monitor circuit 220 including a photocoupler PC_2. Resetting circuits 221 and 222 are connected to the transmission processing circuit 210 and dimming control circuit 216, respectively, so that the circuits 210 and 216 are reset when they are connected to the signal line 4 and thereby supplied with power.

With the construction described above, upon reception of the transmission signal V_S from the central control unit 1, the dimming control terminal unit 3a compares the address data included in the transmission signal V_S with the address data stored in the data memory section 213. If they coincide with each other, the dimming control circuit 216 sets the dimming level on the basis of the control data included in the subsequent transmission signal V_S to control the light output of the light load L_1.

An instruction for adjusting the light output of the light load L_1 connected to the dimming control terminal unit 3a is given by the manipulation of the button switches S_5 and S_6 of the corresponding dimming switch terminal unit 2a. Upon reception of the control data generated in response to the depression of the switch S_5, the dimming control terminal unit 3a starts increasing the light output of the associated light load L_1. Then, when the switch S_5 is released (recognizing that the output level has reached an appropriate level), the dimming control terminal unit 3a stops the light output increase of the light load L_1 and thereafter keeps the light output level. On the other hand, upon depression of the switch S_6, the dimming control circuit 3a starts decreasing the light output of the associated light load L_1. Then, when the switch S_6 is released, the dimming control terminal unit 3a stops the light output decrease and thereafter keeps the light output level. Since the dimming level is returned from the dimming control terminal unit 3a to the central control unit 1, when the system is restored from an electric power failure the preceding dimming level can be restored.

Figs. 20 and 21 show the structure of the dimming control terminal unit 3a. The above-described circuits are housed in a case 230 whose dimensions are normalized according to the Japanese Industrial Standard (C-8370, Supplement 5). The case 230 is formed by fitting a box-like body 30a open to the upper side in Fig. 20 to a cover 230b using screws 31. Terminal dents 232a for receiving the terminals t_1-t_3 are formed on the both sides of the cover 232a. Within each of the dents 232a, a terminal plate 232c is arranged, with which a terminal screw 232b is engaged. Part of the terminal dents 232a corresponding to the terminals t_2 and t_3, which are to be connected to the commercial power line AC and the light load L_1, respectively, are cover with a terminal cover 232e which is fixed to the top surface of the cover 230b by a fixing screw 232d. Formed in the top surface of the cover 230b are a transmissive window 233b provided with a filter 233a for transmitting light emitted from the light-emitting element LD_1 and light to be received by the photodetector PD_1, and another transmissive window 233c for transmitting light emitted from the light-emitting element LD_2. A transparent nameplate 34 is also fitted to the top surface of the cover 230. A first printed circuit board 235a on which the phase control circuit 217 is mounted, and a second printed circuit board 235b on which other circuit components are mounted are housed in the case 230 such that the two boards 235a and 235b are apart from each other in the vertical direction. The power control device T is fixed by a screw 237 on a metal radiator plate 236 provided under the first printed circuit board 235a. The first printed circuit board 235a is fixed to bosses 238a provided at the internal periphery of the body 230a by screws 238b, and the radiator plate 236 is fixed to a boss 239a provided at the center of the body 230a by a screw 239b. The second printed circuit board 235b is fixed to the bottom side of the cover 230b by a screw 239.

Connecting holes 240 for a fixing member which is used for fixing the case 230 to a distribution switchboard are formed at the bottom portions of the both side faces of the body 230a. As shown in Fig. 22, the connecting holes 240 communicate with ventilation openings 242 provided over steps 241 provided inside the body 230a. Legs 236a are

protruded from the periphery of the radiator plate 236 so that the main part of the radiator plate 236 is apart from the bottom face of the body 230a and forms the ventilation openings 242. Further, the radiator plate 236 is designed such that almost all the circumference thereof can be in contact with the inside surface of the body 230a. Therefore, on the lower side of the radiator plate 236, external air can be introduced into the body 230a through the connecting holes 240 and the ventilation openings 242, and heat can efficiently be radiated from the radiator plate 236 to the outside of the case 230 by contacting the air flow (shown by arrows in Fig. 22) to the radiator plate 236. With the above structure, the radiator plate 236 is not exposed from the case 230 and hence a good appearance is obtained while keeping efficient dissipation of heat from the power control device T.

In the dimming control terminal unit 3a of the above embodiment, the case 230 has normalized dimensions according to the distribution switchboard standard, and the radiator plate 236 thermally connected to the power control device T is arranged within the case 230 and the connection holes 240 are formed in the side faces of the case 240 to introduce external air into the case 240 and to make it contact with the radiator plate 236. Therefore, the case 230 can be installed in a distribution switchboard, and the heat generated by the power control device T can effectively be radiated without exposing a radiator plate from the case 230. Since the connecting holes 240 are also used to fix the case 230 to a switchboard, the connecting holes 240 are hardly seen from the outside, providing a good appearance of a switchboard assembly. Further, since the address setting section is arranged on the front face of the case 230, the address data can be set while the case 230 is kept installed in the switchboard, providing easiness in the address setting or alteration.

Claims

1. A remote supervisory and controlling system in which a plurality of terminal units are connected to a central control unit through a two-wire signal line, and the central control unit accesses each of the terminal units to perform time-divisional multiplex transmission of monitor data and control data between the central control unit and each of the terminal units, said system comprising:
   a dimming switch terminal unit, connected to the signal line, for monitoring at least a dimming-up switch and a dimming-down switch;
   a dimming control terminal unit, connected to the signal line, for performing dimming-up and dimming-down control of an associated light load; and
   the central control unit, for, upon depression of the dimming-up switch or dimming-down switch, detecting dimming monitor data sent from the dimming switch terminal unit which indicates depression of the dimming-up switch or dimming down switch and sending to the dimming control terminal unit first control data which instructs it to start the dimming-up or dimming down control, and for, upon release of the dimming-up switch or dimming-down switch, sending to the dimming control terminal unit second control data which instructs it to stop the dimming-up or dimming-down control;
   wherein the dimming control terminal unit continues by itself the dimming-up or dimming-down control during a period from reception of the first control signal to reception of the second control signal.

2. The system according to claim 1, wherein each time a predetermined variation has occurred in a dimming level of the light load, the dimming control terminal unit sends to the central control unit level monitor data indicating the dimming level of the associated light load, the central control unit sends third control data indicating the dimming level to the dimming switch terminal unit, and the dimming switch terminal unit indicates the dimming level on the basis of the third control data.

3. The system according to claim 1, further comprising:
   a group dimming terminal unit, connected to the signal line, for monitoring at least a group dimming-up switch and a group dimming-down switch; and
   memory means, provided in the central control unit, for storing addresses of selected ones of the dimming control terminal units;
   wherein when the group dimming-up switch or group dimming-down switch of the group dimming terminal unit is manipulated, the central control unit controls the selected ones of the dimming control terminal units on the basis of the addresses stored in the memory means and group monitor data sent from the group dimming terminal unit which indicates manipulation of the group dimming-up switch or group dimming-down switch so that a plurality of the light loads connected to the respective selected ones of the dimming control terminal units are subjected to dimming control at once.

4. The system according to claim 3, wherein the

memory means comprises an electrically erasable programmable ROM.

5. The system according to claim 1, wherein the dimming switch terminal unit further monitors an on/off switch, the dimming control terminal unit further performs on/off control of the associated light load; and the central control unit detects on/off monitor data sent from the dimming switch terminal unit which indicates manipulation of the on/off switch, and sends to the dimming control terminal unit on/off control data which instructs it to turn on or turn off the associated light load.

6. The system according to claim 5, wherein the dimming switch terminal unit comprises:
a terminal unit case;
the dimming-up switch, the dimming-down switch and the on/off switch, all of which are arranged on a front face of the terminal unit case;
a signal processing circuit for generating the dimming monitor data and the on/off monitor data;
an address setting section including an electrically erasable programmable ROM for setting an own address of the dimming switch terminal unit;
an optical signal receiver section for receiving an optical signal representing the own address to be set in the address setting section; and
a manipulation block comprising, as integral parts, three manipulation handles to be depressed to actuate the dimming-up, dimming-down and on/off switches, respectively.

7. The system according to claim 1, wherein the dimming control terminal unit comprises:
a terminal unit case having normalized dimensions;
a transmission processing circuit for recognizing the first and second control data sent from the central control unit;
an address memory section for storing an own address of the dimming control terminal unit;
a dimming circuit including a power control device for dimming the associated light load;
a dimming control circuit for phase-controlling the dimming circuit;
an address setting section, arranged on a front face of the terminal unit case, for setting the own address;
a radiator plate arranged within the terminal unit case and thermally coupled with the power control device; and
connecting holes, formed in side faces of the terminal unit case and capable of being connected to fixing metal fittings for fixing the terminal unit case to a distribution switchboard, for introducing external air to be in contact with the radiator plate.

8. The system according to claim 7, wherein the address setting section comprises a photodetector for detecting a first optical signal carrying address data, and a light-emitting element for emitting a second optical signal carrying confirmation data, and wherein the dimming control terminal unit further comprises a transmissive window capable of transmitting the first and second optical signal.

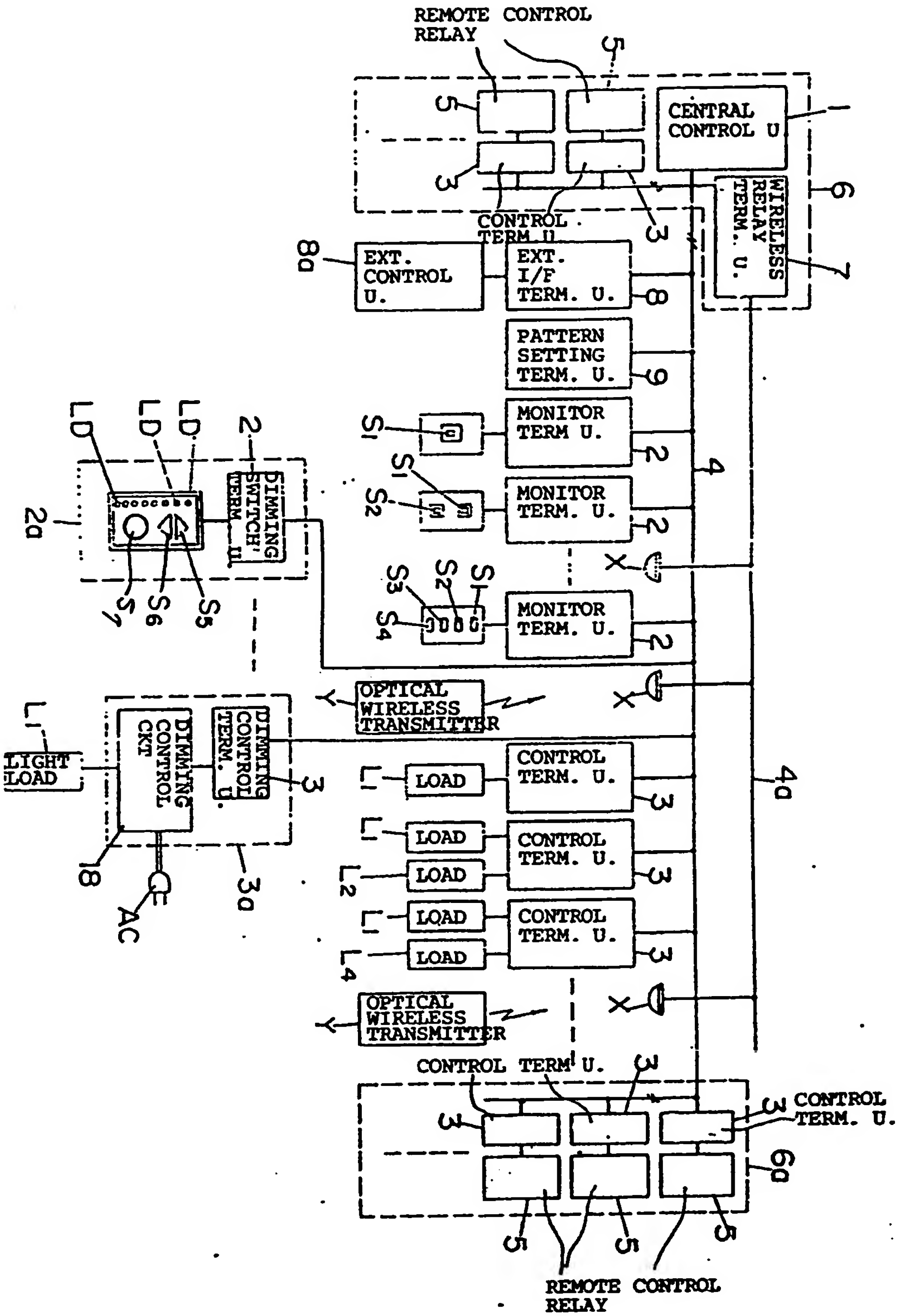

REMOTE CONTROL
RELAY
CENTRAL
CONTROL U
WIRELESS
RELAY
TERM. U.
CONTROL
TERM U.
EXT.
CONTROL
U.
EXT.
I/F
TERM. U.
PATTERN
SETTING
TERM. U.
MONITOR
TERM U.
MONITOR
TERM. U.
MONITOR
TERM. U.
DIMMING
SWITCH
TERM. U
OPTICAL
WIRELESS
TRANSMITTER
DIMMING
CONTROL
TERM. U.
DIMMING
CONTROL
CKT
LIGHT
LOAD
LOAD
CONTROL
TERM. U.
LOAD
LOAD
CONTROL
TERM. U.
LOAD
LOAD
CONTROL
TERM. U.
OPTICAL
WIRELESS
TRANSMITTER
CONTROL TERM U.
CONTROL
TERM. U.
REMOTE CONTROL
RELAY
AC
LD
2a
2
3a
4
4a
6
6a
7
8
8a
9
18

FIG. 1

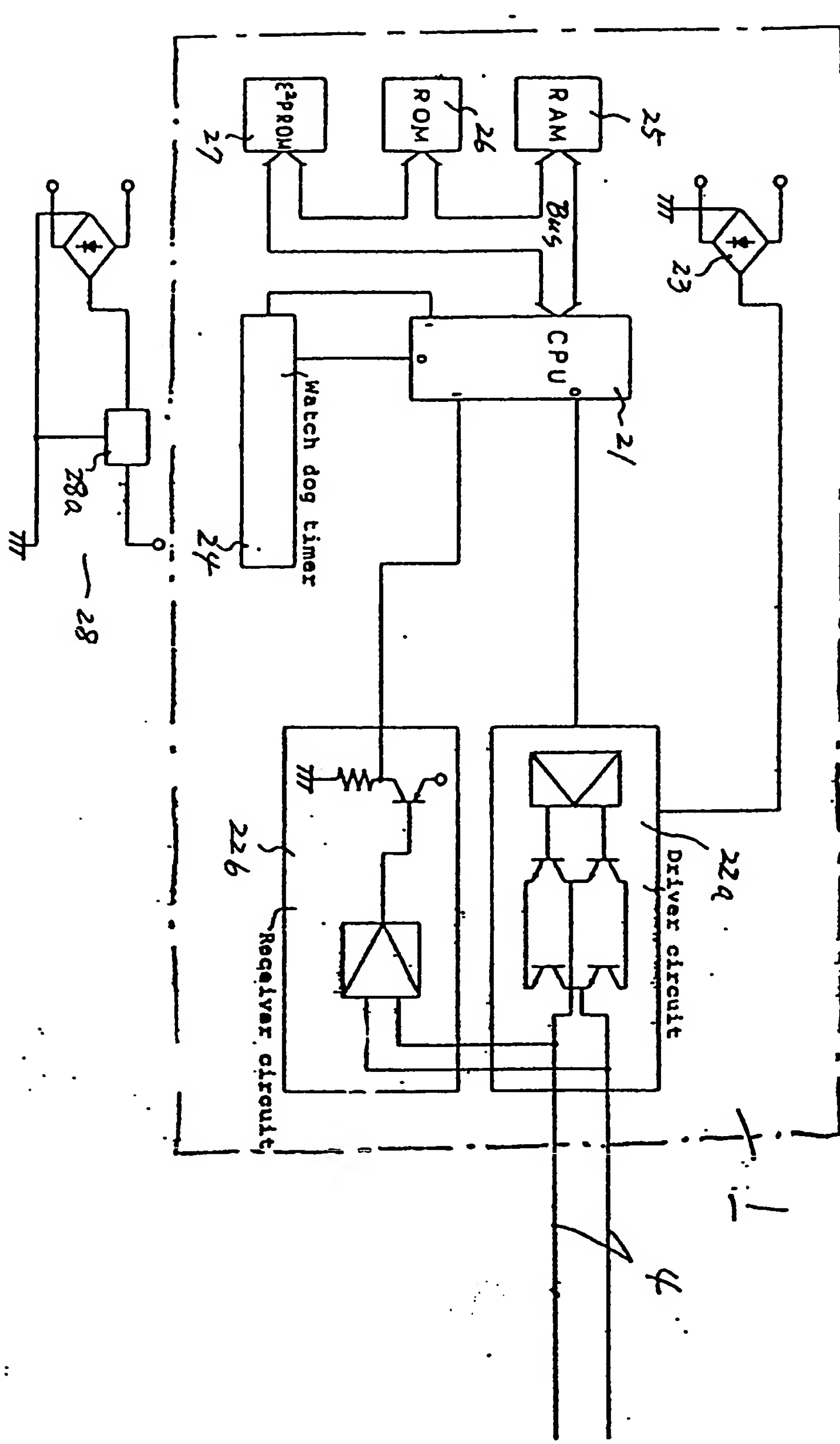
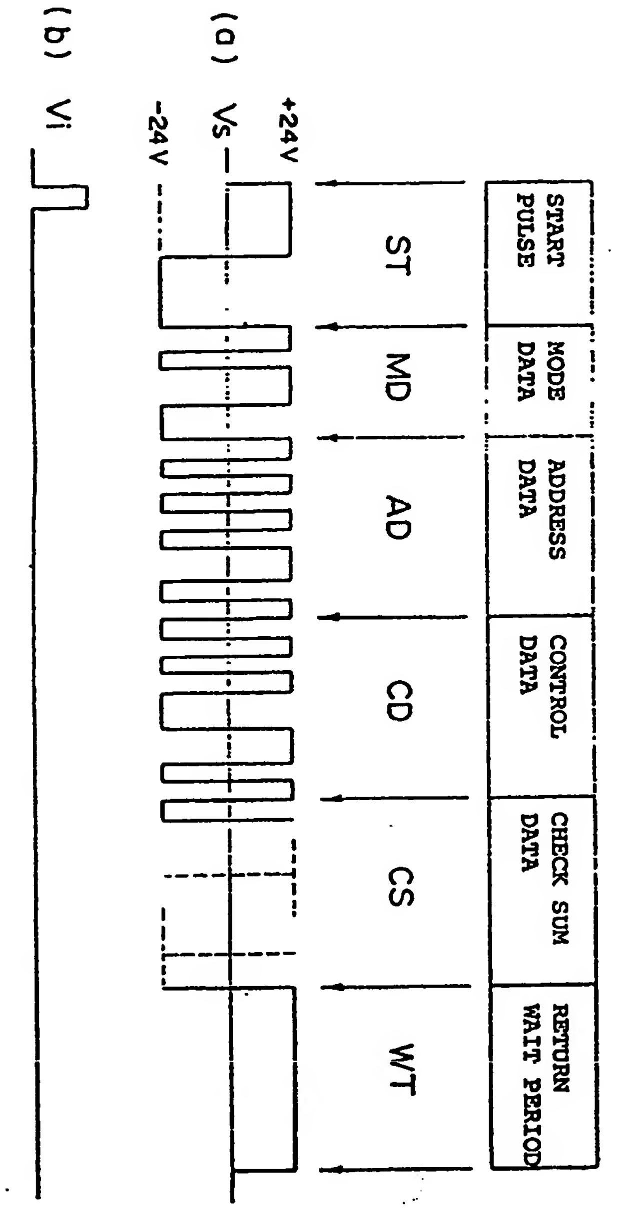

E²PROM
ROM
RAM
Bus
CPU
Watch dog timer
Driver circuit
Receiver circuit
21
22a
22b
23
24
25
26
27
28
28a
1
4

FIG. 1A

FIG. 2


START PULSE
MODE DATA
ADDRESS DATA
CONTROL DATA
CHECK SUM DATA
RETURN WAIT PERIOD
ST
MD
AD
CD
CS
WT
+24V
-24V
(a) Vs
(b) Vi

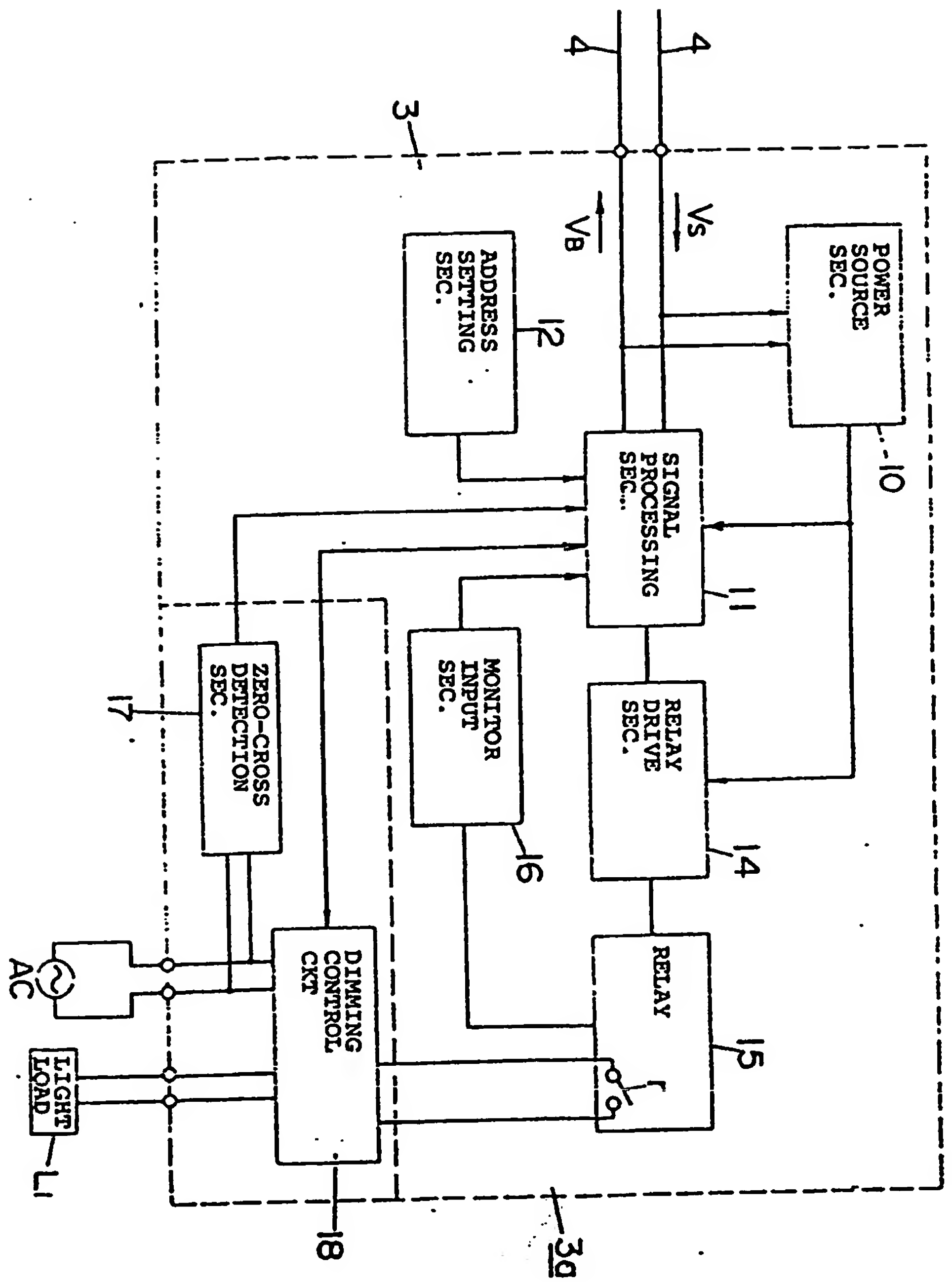

4
4
3
V_S
V_B
POWER SOURCE SEC.
10
ADDRESS SETTING SEC.
12
SIGNAL PROCESSING SEC.
11
RELAY DRIVE SEC.
14
RELAY
r
15
MONITOR INPUT SEC.
16
ZERO-CROSS DETECTION SEC.
17
DIMMING CONTROL CKT
18
AC
LIGHT LOAD
L1
3a

FIG. 3

FIG. 4(a)

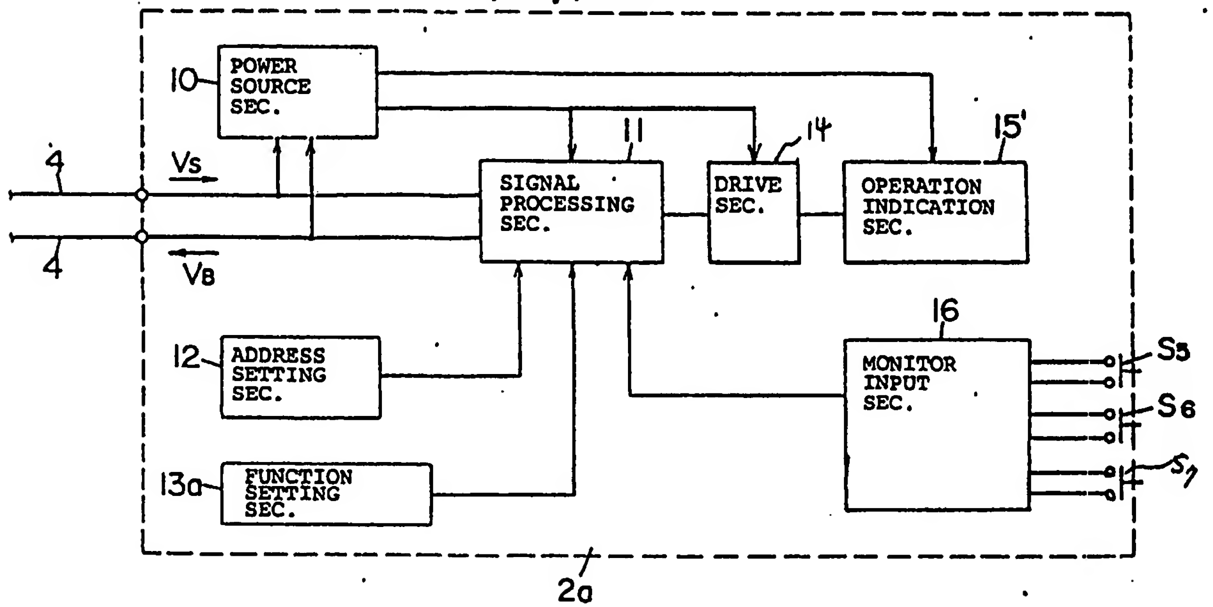


FIG. 4(b)

0	0	0	0	SW		
0	0	0	1	SW	DELAYED OFF	30 SEC.
0	0	1	0	SW	DELAYED OFF	5 MIN.
0	0	1	1	SW	TEMPORARY ON	30 SEC.
0	1	0	0	SW	TEMPORARY ON	5 MIN.
0	1	0	1	SW	UP DOWN	
1	0	0	0	CT		
1	0	0	1	CT	DELAYED OFF	30 SEC.
1	0	1	0	CT	DELAYED OFF	1 MIN.
1	0	1	1	CT	DELAYED OFF	5 MIN.
1	1	0	0	SW	DELAYED OFF	1 MIN.
1	1	0	1	SW	TEMPORARY ON	1 MIN.
1	1	1	0	SW	TEMPORARY ON	1 HR.
1	1	1	1	SW	TEMPORARY ON	2 HR.

COMBINED ACTION OF CONTACTS

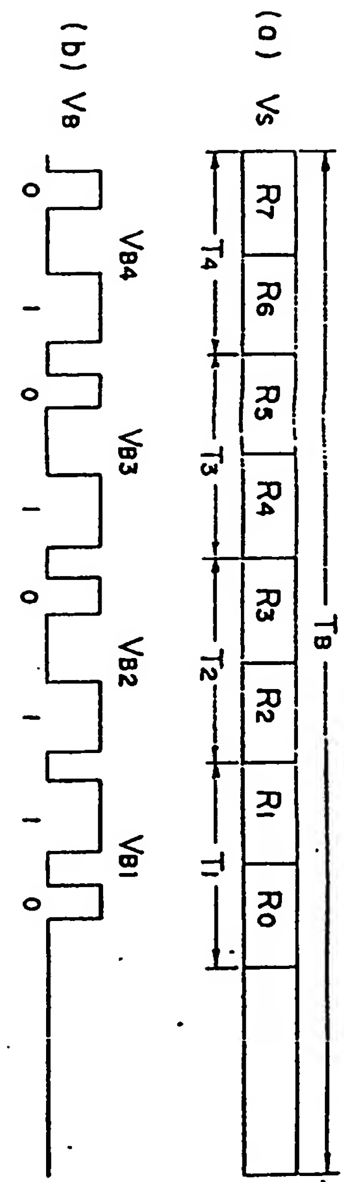

(a) Vs
R7
R6
R5
R4
R3
R2
R1
R0
TB
T4
T3
T2
T1
(b) VB
VB4
VB3
VB2
VB1
0
1
0
1
0
1
1
0

FIG. 5

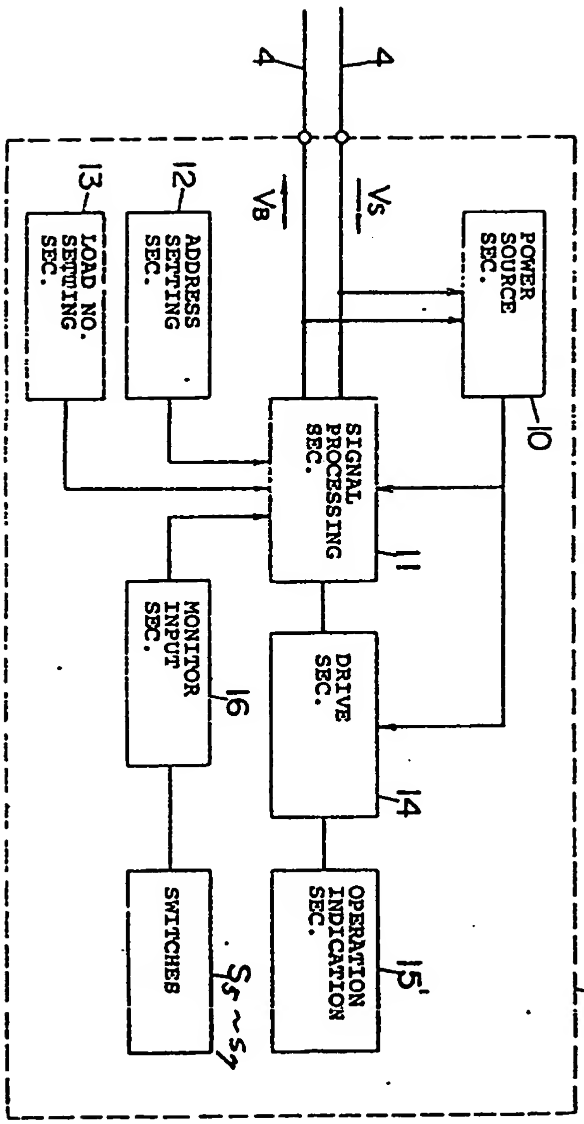

4
4
Vs
VB
POWER SOURCE SEC.
10
SIGNAL PROCESSING SEC.
11
ADDRESS SETTING SEC.
12
LOAD NO. SETTING SEC.
13
DRIVE SEC.
14
MONITOR INPUT SEC.
16
OPERATION INDICATION SEC.
15'
SWITCHES
S5~S7
2a'

FIG. 6

FIG. 7

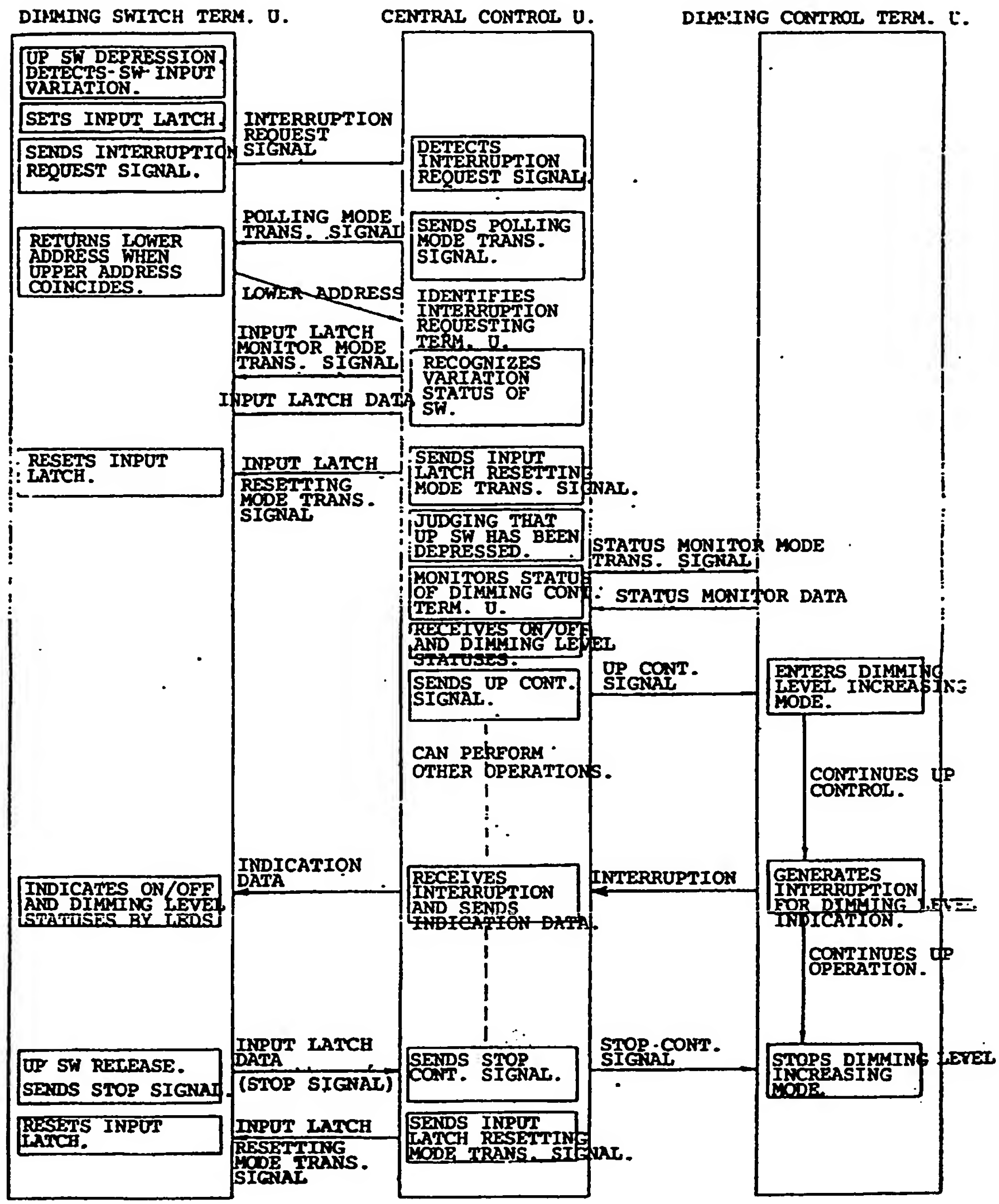

DIMMING SWITCH TERM. U.
CENTRAL CONTROL U.
DIMMING CONTROL TERM. U.
UP SW DEPRESSION DETECTS SW INPUT VARIATION.
SETS INPUT LATCH.
SENDS INTERRUPTION REQUEST SIGNAL.
INTERRUPTION REQUEST SIGNAL
DETECTS INTERRUPTION REQUEST SIGNAL.
POLLING MODE TRANS. SIGNAL
SENDS POLLING MODE TRANS. SIGNAL.
RETURNS LOWER ADDRESS WHEN UPPER ADDRESS COINCIDES.
LOWER ADDRESS
IDENTIFIES INTERRUPTION REQUESTING TERM. U.
INPUT LATCH MONITOR MODE TRANS. SIGNAL
RECOGNIZES VARIATION STATUS OF SW.
INPUT LATCH DATA
RESETS INPUT LATCH.
INPUT LATCH RESETTING MODE TRANS. SIGNAL
SENDS INPUT LATCH RESETTING MODE TRANS. SIGNAL.
JUDGING THAT UP SW HAS BEEN DEPRESSED.
STATUS MONITOR MODE TRANS. SIGNAL
MONITORS STATUS OF DIMMING CONT. TERM. U.
STATUS MONITOR DATA
RECEIVES ON/OFF AND DIMMING LEVEL STATUSES.
SENDS UP CONT. SIGNAL.
UP CONT. SIGNAL
ENTERS DIMMING LEVEL INCREASING MODE.
CAN PERFORM OTHER OPERATIONS.
CONTINUES UP CONTROL.
INDICATION DATA
INDICATES ON/OFF AND DIMMING LEVEL STATUSES BY LEDS.
RECEIVES INTERRUPTION AND SENDS INDICATION DATA.
INTERRUPTION
GENERATES INTERRUPTION FOR DIMMING LEVEL INDICATION.
CONTINUES UP OPERATION.
UP SW RELEASE.
SENDS STOP SIGNAL
INPUT LATCH DATA
(STOP SIGNAL)
SENDS STOP CONT. SIGNAL.
STOP CONT. SIGNAL
STOPS DIMMING LEVEL INCREASING MODE.
RESETS INPUT LATCH.
INPUT LATCH RESETTING MODE TRANS. SIGNAL
SENDS INPUT LATCH RESETTING MODE TRANS. SIGNAL.

FIG. 8

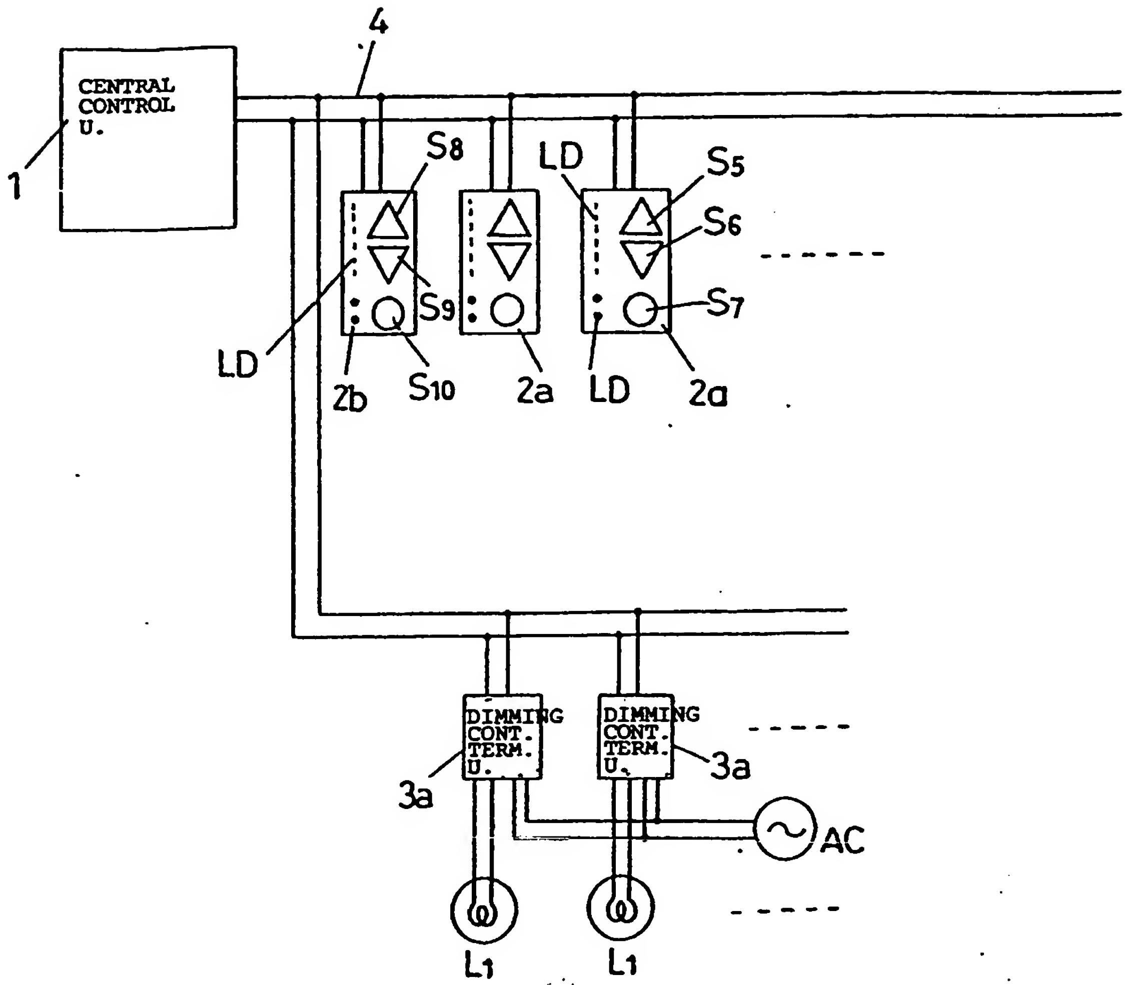
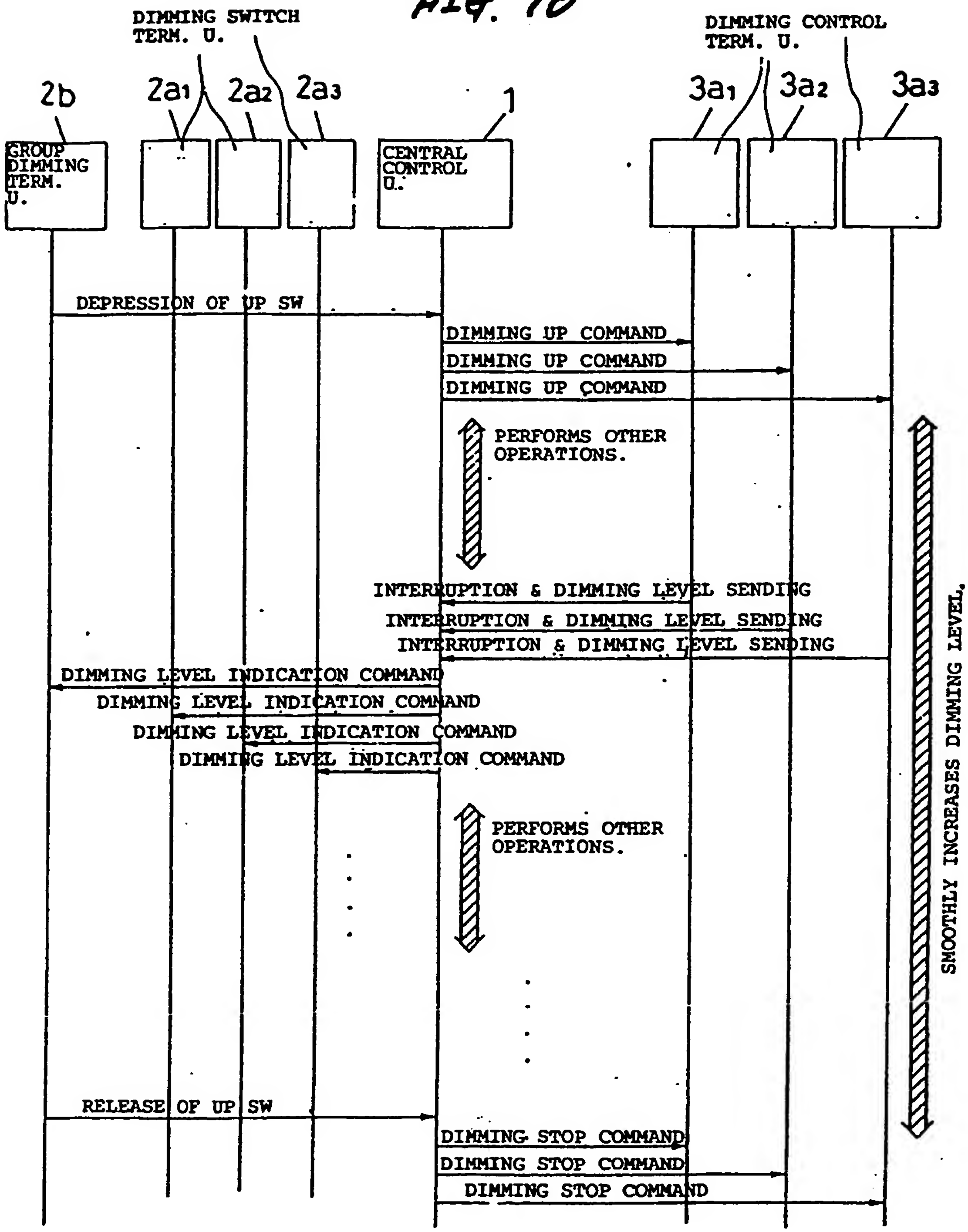

4
CENTRAL CONTROL U.
1
S8
LD
S5
S6
S9
S7
LD
S10
2b
2a
LD
2a
DIMMING CONT. TERM. U.
DIMMING CONT. TERM. U.
3a
3a
AC
L1
L1

FIG. 9

	DIMMING SWITCH TERM. U.															
GROUP NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	O	O	O	O	O											
2						O	O	O	O	O						
3											O	O	O	O	O	O
4	O		O		O		O		O		O		O		O	
5	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

FIG. 10


DIMMING SWITCH TERM. U.
DIMMING CONTROL TERM. U.
2b
2a1
2a2
2a3
1
3a1
3a2
3a3
GROUP DIMMING TERM. U.
CENTRAL CONTROL U.
DEPRESSION OF UP SW
DIMMING UP COMMAND
DIMMING UP COMMAND
DIMMING UP COMMAND
PERFORMS OTHER OPERATIONS.
INTERRUPTION & DIMMING LEVEL SENDING
INTERRUPTION & DIMMING LEVEL SENDING
INTERRUPTION & DIMMING LEVEL SENDING
DIMMING LEVEL INDICATION COMMAND
DIMMING LEVEL INDICATION COMMAND
DIMMING LEVEL INDICATION COMMAND
DIMMING LEVEL INDICATION COMMAND
PERFORMS OTHER OPERATIONS.
RELEASE OF UP SW
DIMMING STOP COMMAND
DIMMING STOP COMMAND
DIMMING STOP COMMAND
SMOOTHLY INCREASES DIMMING LEVEL.

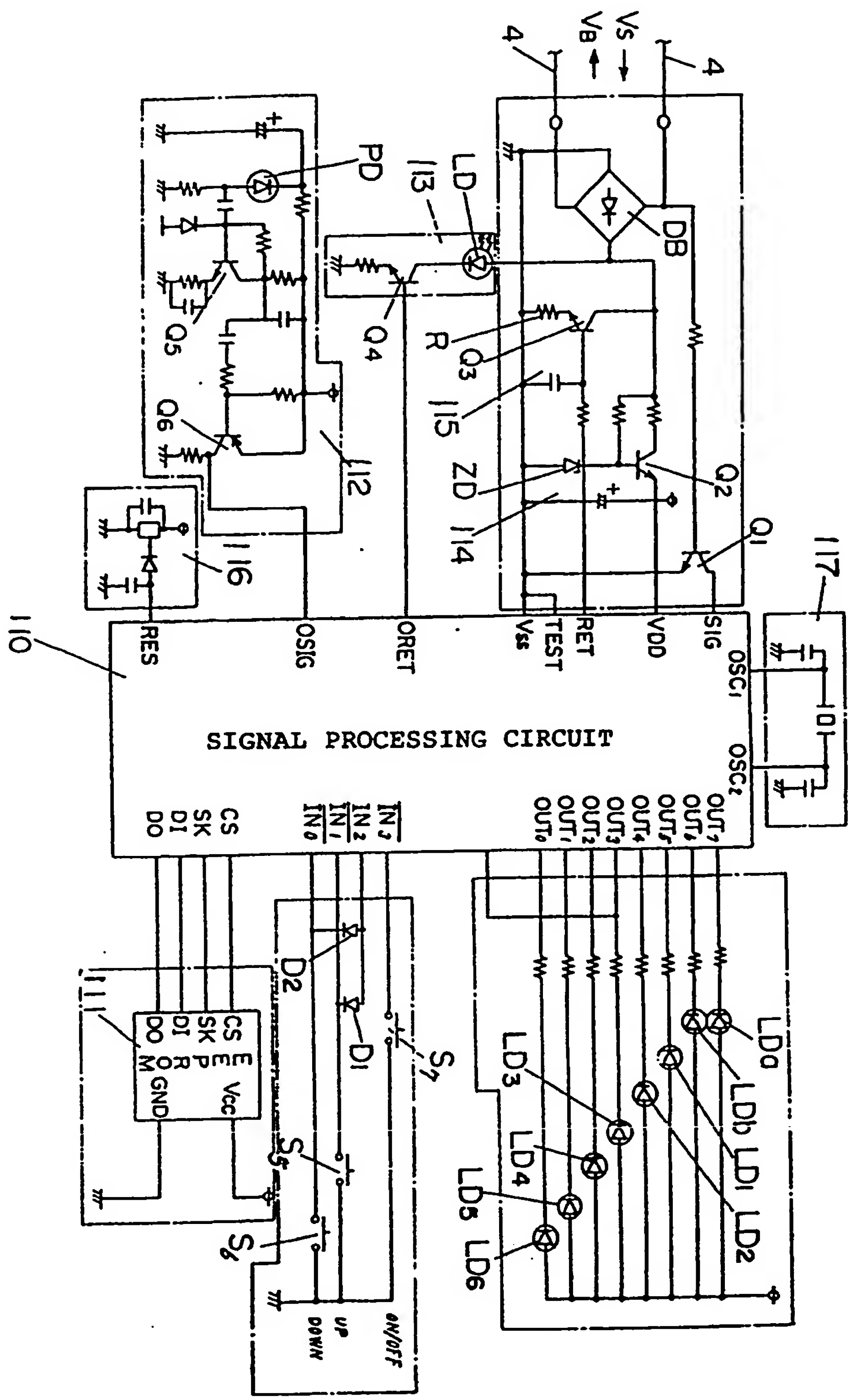

SIGNAL PROCESSING CIRCUIT
RES
OSIG
ORET
Vss
TEST
RET
VDD
SIG
OSC1
OSC2
OUT7
OUT6
OUT5
OUT4
OUT3
OUT2
OUT1
OUT0
IN3
IN2
IN1
IN0
CS
SK
DI
DO
E
P
R
O
M
Vcc
GND
Vs
VB
DB
LD
PD
Q1
Q2
Q3
Q4
Q5
Q6
R
ZD
D1
D2
S5
S6
S7
LDa
LDb
LD1
LD2
LD3
LD4
LD5
LD6
ON/OFF
UP
DOWN
4
101
110
111
112
113
114
115
116
117

FIG. 11

FIG. 12

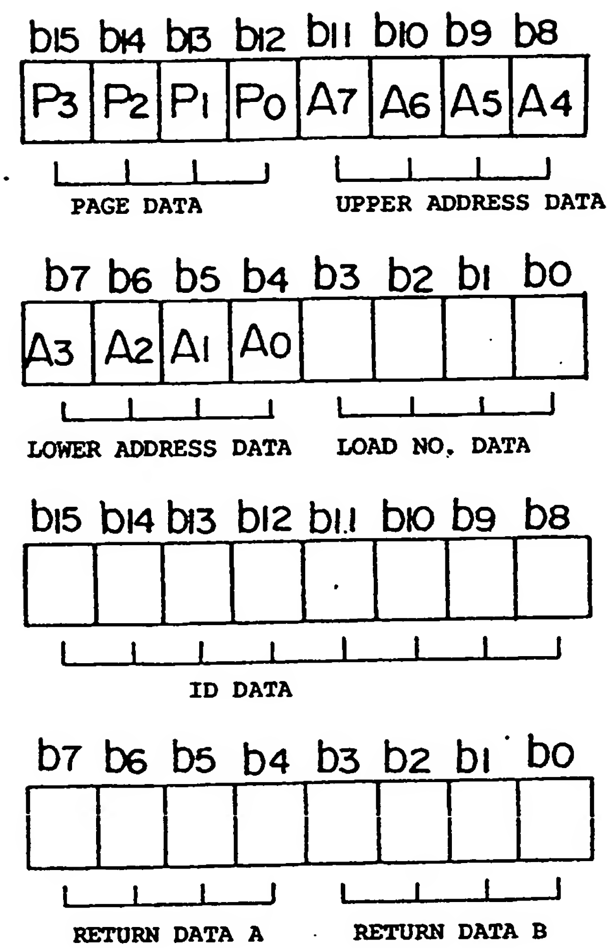

b15 b14 b13 b12 b11 b10 b9 b8
P3 P2 P1 P0 A7 A6 A5 A4
PAGE DATA
UPPER ADDRESS DATA
b7 b6 b5 b4 b3 b2 b1 b0
A3 A2 A1 A0
LOWER ADDRESS DATA
LOAD NO. DATA
b15 b14 b13 b12 b11 b10 b9 b8
ID DATA
b7 b6 b5 b4 b3 b2 b1 b0
RETURN DATA A
RETURN DATA B

FIG. 13

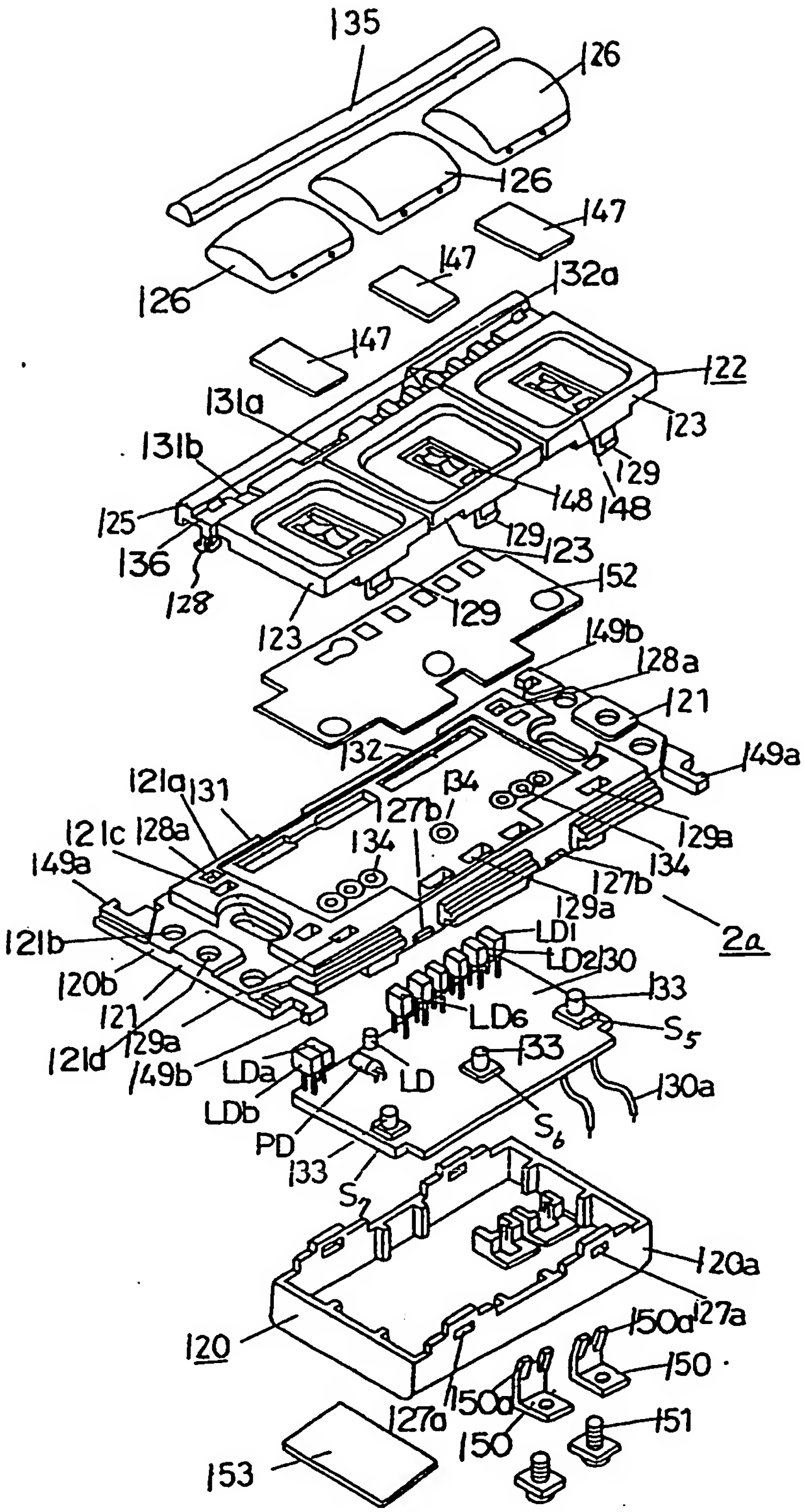

135
126
126
147
126
147
132a
147
122
131a
123
131b
129
148
148
125
129
123
136
152
128
129
123
149b
128a
121
132
149a
121a
131
134
127b
121c
128a
134
129a
149a
134
127b
129a
2a
121b
LD1
LD2
130
120b
133
121
LD6
S5
129a
133
121d
149b
LDa
LD
130a
LDb
S6
PD
133
S7
120a
127a
150a
120
150
150a
127a
151
150
153

FIG. 14

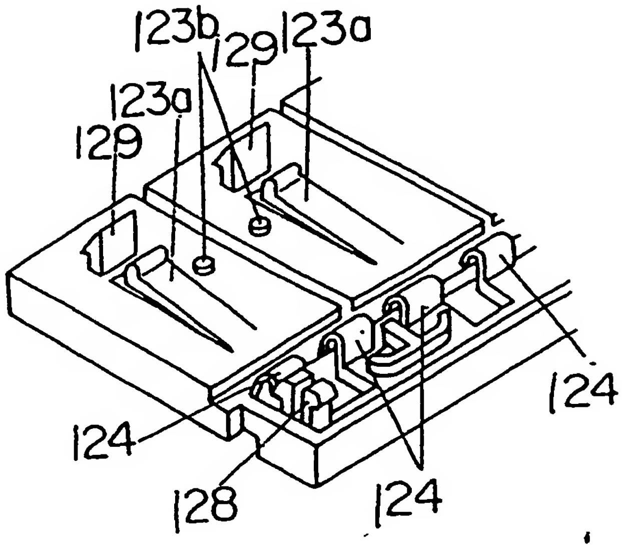

123b
129
123a
123a
129
124
124
128
124

FIG. 15

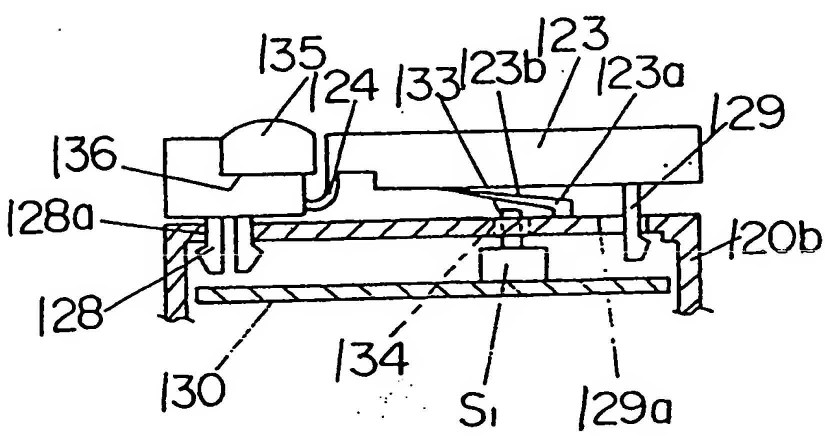

135
124
133
123b
123
123a
129
136
128a
120b
128
134
130
S1
129a

FIG. 16

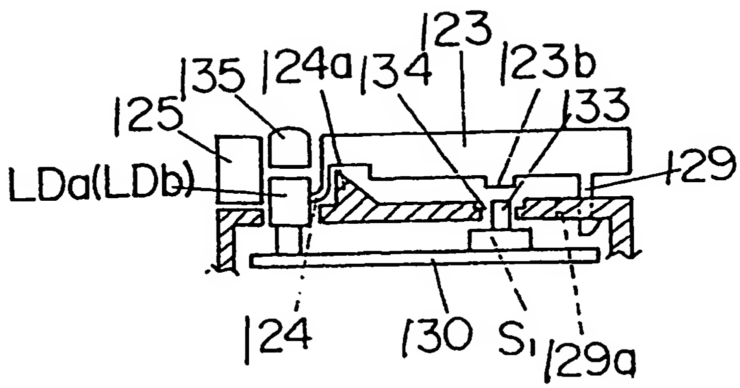


FIG. 17

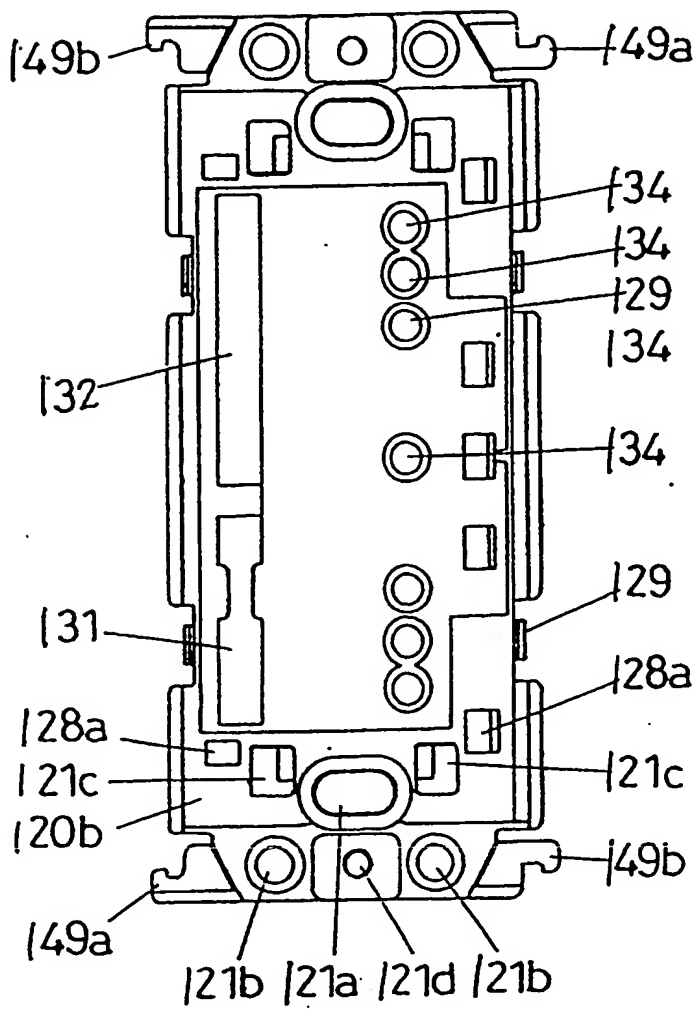
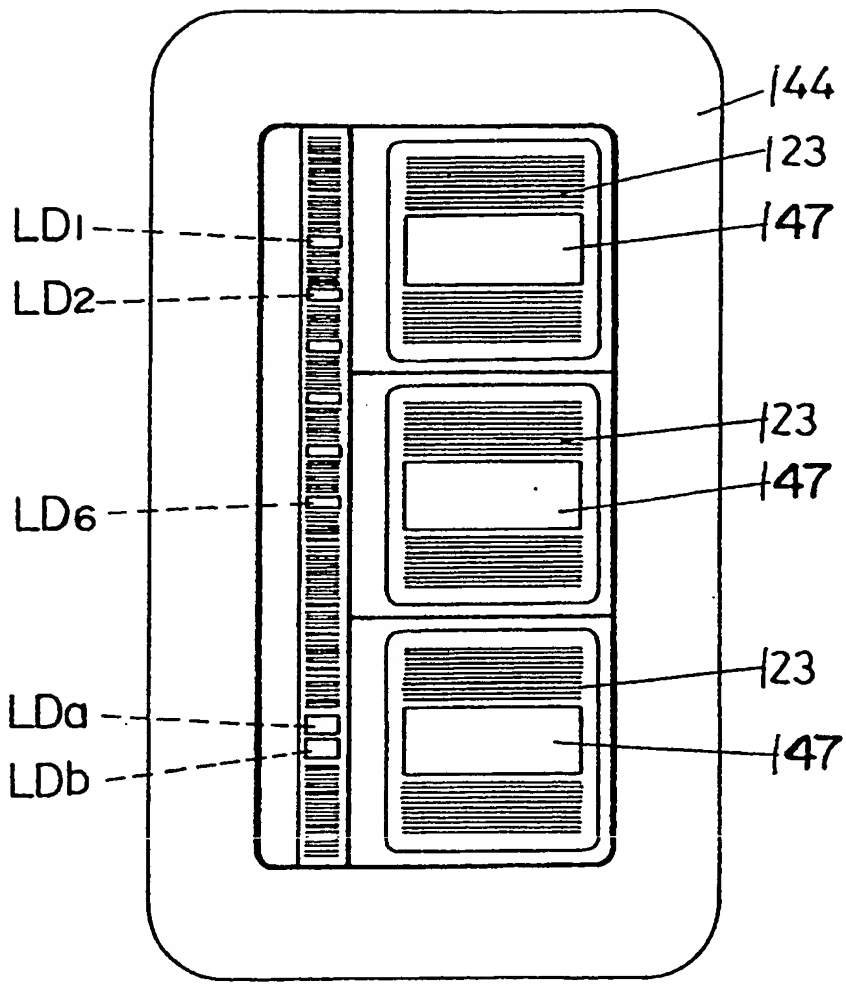

149b
149a
134
134
129
134
132
134
131
129
128a
128a
121c
121c
120b
149b
149a
121b
121a
121d
121b

FIG. 18



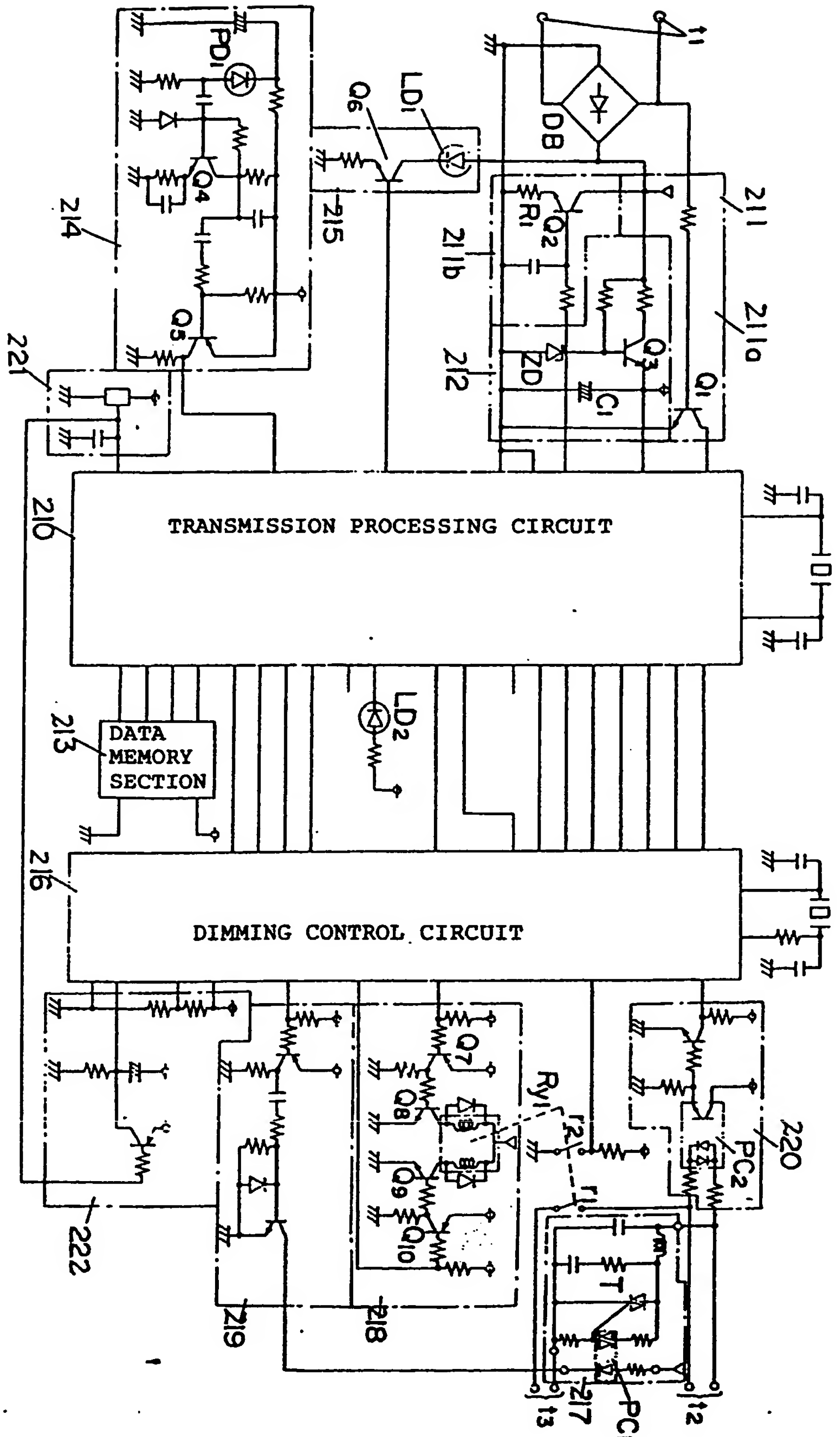

TRANSMISSION PROCESSING CIRCUIT
DATA MEMORY SECTION
DIMMING CONTROL CIRCUIT
DB
LD1
LD2
PD1
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
R1
ZD
C1
Ry1
r1
r2
PC1
PC2
t1
t2
t3
211
211a
211b
212
213
214
215
216
217
218
219
220
221
222

FIG. 19

FIG. 20

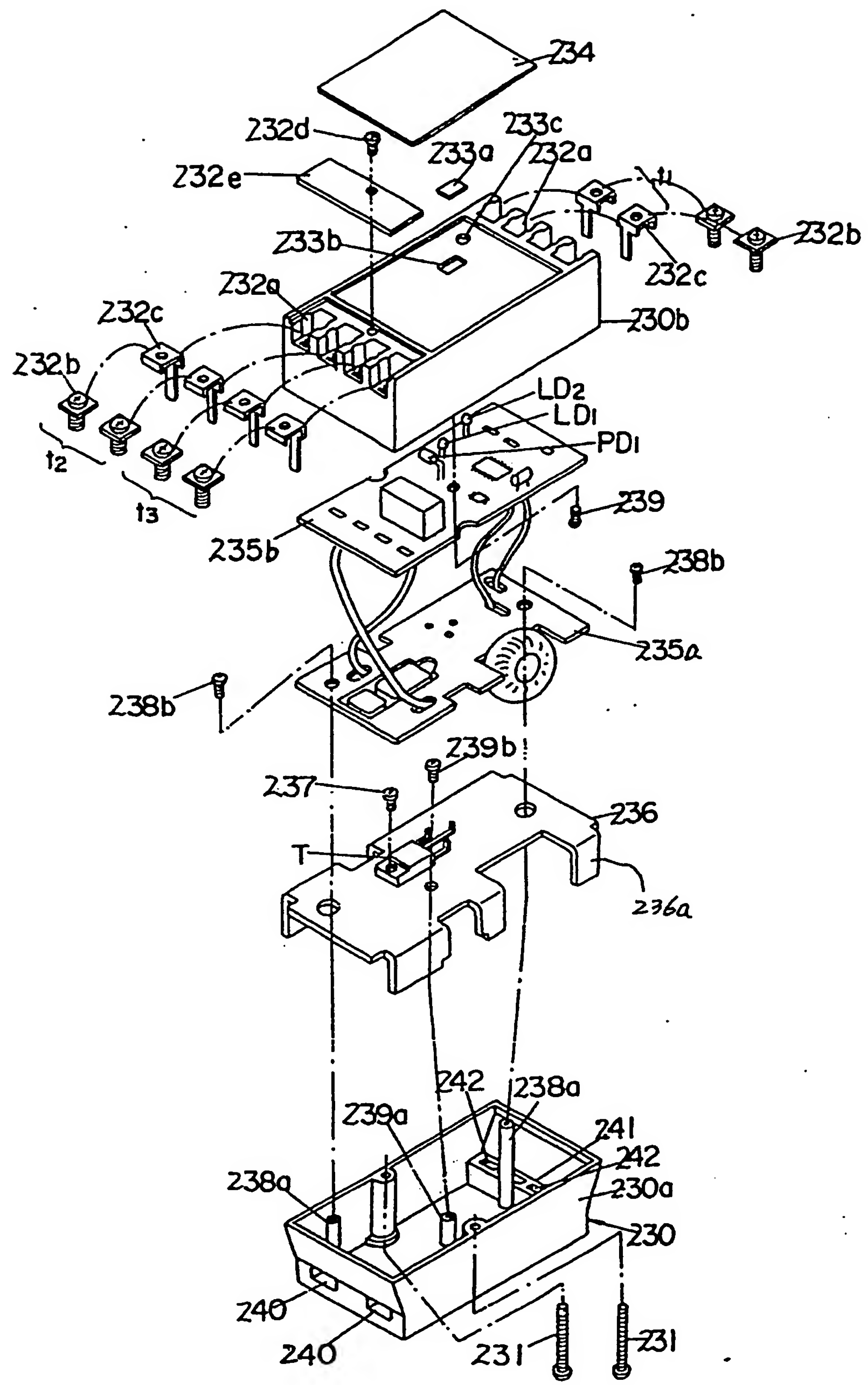

234
232d
233c
233a
232a
t1
232e
232b
233b
232c
232a
232c
230b
232b
LD2
LD1
PD1
t2
t3
239
235b
238b
235a
238b
239b
237
236
T
236a
242
238a
239a
241
242
238a
230a
230
240
240
231
231

FIG. 21

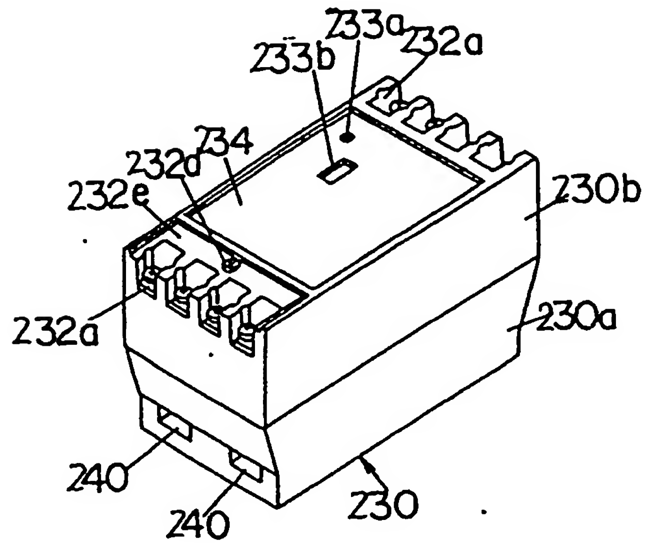
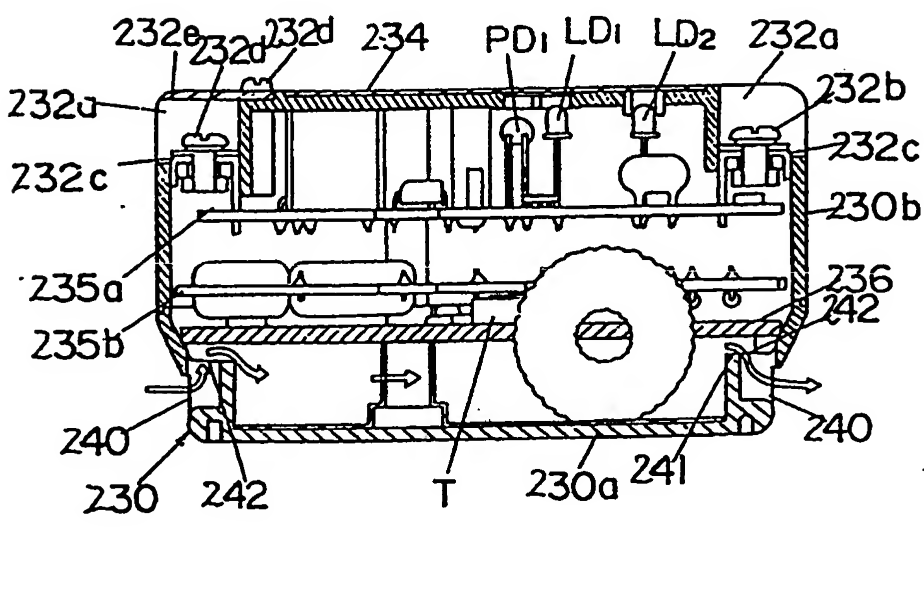

233a
232a
233b
234
232d
232e
230b
232a
230a
240
240
230

FIG. 22


232e
232d
232d
234
PD1
LD1
LD2
232a
232a
232b
232c
232c
230b
235a
236
242
235b
240
240
230
242
T
230a
241